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ABSTRACT

Extensive data is presented which clarifies the number and percentage of persons who complete high school and college. Historical trends for the elementary, secondary and college levels are included. The report takes note of a number of growth and constraint factors: (1) wars, depressions, and the higher social cost of post-secondary instruction; (2) the Higher Education Facilities Act of 1963 and the Higher Education Act of 1965 and the resultant growth of community colleges; and (3) the G.I. bill. In general, elementary and secondary education are nearly universal, while the college B.A. continues to be a minority commodity. Decreasing attrition rates and increasing costs are also discussed. A quantitative model is proposed which suggests the manner in which future enrollment might be distributed by level under different policies for the growth of post-secondary instruction. Within the context of this model, two possible future states for the quantity of instruction are illustrated. (Author/TL)

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# THE QUANTITY OF FORMAL INSTRUCTION IN THE UNITED STATES

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# INTRODUCTION

To address future alternatives for financing post-secondary instruction requires some answers to the prior questions: How much instruction? Of what kind? For what purpose? For whom? It is the first of these questions and, to some extent, the last which have been addressed in this research.

However, no policy research group can provide absolute answers to such questions. New answers will be provided in the future and are provided daily by the revealed choices of the individual members of our society and their respective agents. But, policy research groups can attempt to raise old questions in new ways, seek new alternatives, and describe possible outcomes in the hope that future social choice may be somewhat more informed than has been the case in the past. This is a report of a beginning attempt to do this in the field of post-secondary education.

Most of the analysis which has been done in the past has addressed specific components of the educational system independently without reference to the system as a whole. Because of the various components of the educational system have developed independently, this procedure has been reasonable. Indeed, there has been good reason for believing that no single homogeneous system exists which encompasses the wide variety of instruction which is offered at many different levels with many different objectives. Nevertheless, at the outset of this work, it was decided to examine the system as a whole. The purpose adopted here was to bring together available data on as many separate components of the system as might be examined within the time allowed and to discover whether understandable relationships might not

exist between them. It is hoped that future planning for education might benefit from knowledge of some of the relationships described here.

The historical analysis presented in Section I of this report describes what is possibly the most significant event of the 20th Century in the development of educational institutions in the United States. This is the development and maturation of a nearly universal system of secondary school instruction. Post-secondary institutions, however, have developed independently of this movement. Until about 1930, the quantity of post-secondary instruction produced by institutions of higher education was more than adequate to serve the needs of then current generations of young people, less than 30 per cent of whom ever completed secondary school. Since that time, however, the output of the secondary schools has persistently grown such that, sometime between 1950 and 1960, the secondary school experience of youth became an uninterrupted extension of elementary school experience. More than 80 per cent of today's generation will complete secondary school.

Partly because of wars, partly because of the economic depression of the 1930's, and partly because of the economic demand for alternative uses of the time of young people, growth in the quantity of post-secondary instruction at institutions of higher education has not kept pace with the development of secondary instruction. Although significant growth in the quantity of post-secondary instruction has occurred, and, it is safe to say, will continue to occur, the proportion of high school graduates who complete a four-year post-secondary degree, nevertheless, stands today roughly what it was about the turn of the Century.

This is now changing. But, should our society wish to afford it, the potential demand for post-secondary instruction created by our secondary schools today far exceeds the current capacity of our existing public and private institutions of higher education. This follows if one accepts one simple proposition: That the amount of time spent in receiving formal instruction imparts some special advantage to an individual as compared to his contemporaries of comparable abilities who have received less. It makes little difference whether one translates such advantage into purely economic terms or into non-economic terms related to the quality of the individual's life and the quality of future society. If one accepts the notion that formal instruction imparts special advantage to an individual, then growth in educational attainment and progress in the dissemination of knowledge will continue, but only to the extent that we as a society choose to allocate our limited economic resources to that end. If growth in educational attainment, as measured by the time spent in receiving instruction, and progress in the dissemination of knowledge are to continue, that growth and progress must occur largely at the post secondary level.

Section II of this report offers one kind of model within which various alternatives for the future quantity of instruction may be examined. The specific model used here was chosen because it describes sequential time processes, of which the acquisition of incremental time units of instruction is one, and because it conveniently accomodates many of the ideals regarding equality of educational opportunity which are believed to be widely shared among the citizens of the United States. The criteria of equality of opportunity adopted here are not new or original. They have been stated many times before by both governmental and non-governmental units both

here and abroad. But, what is new here is the notion that there may be certain logical and practical limits to the growth process, as it pertains to the quantity of instruction produced in the future, within which the goal of equality of educational opportunity might be realized. These suggested limits are described in quantitative terms. However, many alternative future amounts of instruction may be described within these limits.

Two specific alternative future states for the quantity of instruction are described which highlight two possible extremes for future policy. One, in which the average amount of instruction received per person prior to age 35 continuously rises for successive age cohorts, much as it has throughout the 20th Century. And a second, in which the average amount per person is stabilized at a specific level for those individuals who will complete high school within the next few years and for all subsequent generations.

The purpose in this is not to predict what will happen in the future. Rather, the purpose is to provide a quantitative frame of reference within which to analyze what kinds of future policies and what kinds of social and institutional responses to those policies might be needed in order to achieve either of the two extremes.

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## ABSTRACT

The most striking accomplishment of the educational system during the 20th Century has been the growth and maturation of a nearly universal system of secondary school instruction. The proportion of school age generations completing high school has risen from about 5 per cent in 1900 to about 80 per cent today. (pp. 1-5)

Given a conflict between a desire for high standards of achievement on the one hand and a desire for universally available instruction through year 12 on the other, growth in the proportion of successive age cohorts completing year 12 may have been constrained by the learning process itself. (pp. 5-7)

Growth in the proportion of successive age cohorts completing a BA level degree also has been impressive. But growth in this proportion has been constrained by wars, depressions, and a higher social cost of post-secondary instruction. About 80 per cent of today's college age generation will not complete a BA level degree. Although post-World War II veterans' aid permitted some who would not otherwise have gone to college to do so, on net balance, the main effect of this program probably was to compensate for educational losses during the war. Following the more recent student aid legislation of 1965 and subsequent years, college completion rates rose above their long-run trend. (pp. 7-12)

Except for a time during the prosperous 1920's, the proportion of high school graduates completing a BA level degree fell from about 75 per cent in 1875 to a low of about 20 per cent during the late 1930's. Since that time this proportion has shown a gradual rise to about 30 per cent with periods of stability from 1955 to 1965. But, the proportion now stands at about the same value it had at the turn of the Century. (pp. 12-15)

Attrition within four-year degree-credit programs was gradually reduced during the first half of the 20th Century. Although attrition rates may have been increased somewhat during the 1950's, the proportion of those starting a four-year program who complete the process has been stable at about 54 per cent during the 1960's. High school to college entry rates have thus followed much the same long-run pattern as the proportion of high school graduates completing a BA level degree. It is likely that a gradual rise in entry rates has occurred in recent years. (pp. 15-21)

A marked discontinuity in completion rates between school year 8 and 9, evident at the turn of the Century, has been closed with the maturation of the secondary system. Thus, growth in the proportion of subsequent age cohorts completing 12 years of school may be expected to slow. However, a similar discontinuity between years 12 and 13 remains. In the process of reducing the discontinuity between years 8 and 9, attrition between years 9 and 12 first increased and subsequently diminished. (pp. 21-28)

The historical experience for school years 1-8, 8-12, and 13-16 is summarized. (pp. 28-32)

The Higher Education Facilities Act of 1963 and the Higher Education Act of 1965 permitted one of the most significant changes in the institutional structure of the tertiary system since the formation of the land grant colleges during the late 19th Century. This is the growth in enrollment at community colleges. Quite in addition to new forms of post-secondary instruction, these new colleges are now responsible for more than one-third of the current lower-division instruction in traditional four-year programs. During this recent period of change, attrition from year 13 to year 16 has remained unchanged and, according to survey reports from students, the prior preparation of those entering community colleges has improved relative to other institutions. (pp. 32-38)

Universities have responded to persistent and increasing pressures for more graduate level instruction. The proportion of those receiving a BA level degree who have also received an advanced degree has persistently increased since about 1920. There is no indication whether this trend might be altered in the near future. (pp. 38-41)

Constant dollar expenditures on current account per man-year of instruction have persistently increased during the 20th Century at both the elementary-secondary level and for higher education. But, reflecting differences in growth patterns, average expenditures for elementary and secondary

education have increased 11 times since the turn of the Century, while average expenditures for higher education have increased only 2.8 times. Many believe this rising expenditure pattern means that average expenditures per student will continuously rise in higher education due to continuously rising costs of professional services used. Except for relatively brief periods, technological innovation in education apparently has been used to enhance or extend the learning process rather than to reduce the amount of human resources used per student. (pp. 41-46)

Because most instruction at both post-secondary and earlier levels is produced under the auspices of state, local, and Federal governments, the future quantity of instruction will depend mainly on public policies and the social response to those policies. One kind of quantitative model, which accomodates many widely shared ideals regarding equality of educational opportunity, suggest the manner in which future enrollment might be distributed by level under different policies for growth of post-secondary instruction. The distribution is suggested by a continuous attrition function for years of instruction completed by each age cohort. The model produces reasonable implications for both degree-credit and non-degree instruction at the post-secondary level. However, the historical amount of non-degree instruction outside institutions of higher education cannot be verified. (pp. 47-59)

Within the context of this model, two possible futures states for the quantity of instruction are illustrated. One assumes that the mean

number of years of instruction completed prior to age 35 by successive age cohorts will continue to rise from one generation to the next, indefinitely. A second possibility illustrated assumes that, beginning with the generations reaching age 18 during the years 1969-1973, the mean number of years of instruction prior to age 35 would remain constant for all subsequent generations. Both cases assume that specified conditions of equality of educational opportunity would be realized. (pp. 59-63)

# I. SOME HISTORY OF THE QUANTITY OF FORMAL INSTRUCTION IN THE UNITED STATES: 1870-1968

## The High School Level

Chart 1 records what may be one of the most significant accomplishments of the American educational system in this century. The number of high school diplomas awarded has risen from less than 2 per cent of the number of 18-year olds in 1870 to nearly 80 per cent of this segment of the population in the Summer of 1968. [1] [2] With some qualifications regarding the changing age distribution of diploma recipients, one may take the index shown as an approximate measure of the rates at which each generation has attained the diploma. For example, this index indicates that somewhere near 20 per cent of the 1968 generation of students will live out their lives <u>without</u> a high school diploma, as compared to about 95 per cent of the generation of 1900.[1]

Omitting the depression years 1929-39 and the World War II years 1940-45, the ratio of the number of high school graduates to the number of 18-year olds has steadily increased by an average of 1.3 per cent of the number of 18-year olds annually. This growth reflects many factors. But among them, reduced opportunity costs--that is, a reduction in the

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[1] In general, the average age of diploma recipients was likely to be somewhat older in the earlier years than for later years. This would suggest that the slope of a curve showing the proportion of 18-year olds who <u>ever</u> received the diploma would be less steep than that of this index.

CHART 1

A10892

# RATIO OF THE NUMBER OF HIGH SCHOOL DIPLOMAS TO 18 YEAR OLD POPULATION

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number of desirable alternatives to formal study--in a society with a large publicly supported school system, is surely of major importance. Of course, the ratio fell during the World War II period as some 20 per cent of the high school seniors 18 years old or more at the beginning of their last school year entered the armed forces.

Some individuals may argue about the extent to which this educational achievement represents "true" or significant social progress. Such arguments are usually cast in terms of an implied reduction in the quality of the average diploma. The arguments are that the high school graduate of the mid-1800's tended to be a scholar in the classical sense. A high proportion, in fact, went on to institutions of higher education and completed at least the BA level degree.

Certainly, the average content of the high school diploma is vastly different today from what it was 100 years ago. But, the question of the extent to which growth in the proportion of each generation completing high school represents significant progress may be addressed in a different way. An appropriate question is whether a higher proportion of each generation has mastered certain fundamentals of the current corpus of knowledge. A far higher proportion of 18-year olds have a basic literacy. It would seem a safe assertion, for example, that a significantly higher proportion understand the general properties of alternative number systems, have some elementary command of a foreign language, and know more about biology than did Darwin at the time he embarked on the voyage of the Beagle.

This represents significant progress in the dissemination of knowledge. Unfortunately, we know little about what these proportions are or what the quantitative dimensions of the current fundamental corpus of knowledge might be--let alone wisdom.

The argument that the average quality of the high school diploma is probably not as high today as it might have been had this growth not occurred, whether true or not, is quite irrelevant to an objective which seeks a wide dissemination of knowledge. Within the context of this task, the fact that we have created a set of conditions under which at least 80 per cent of subsequent generations will not only be exposed to a full 12 years of formal elementary and secondary schooling but will have achieved some currently acceptable minimum level of performance, as evidenced by the granting of diplomas, is significant indeed.

The objective of a universally available system of elementary and secondary instruction nearly has been realized. Barring any significant shifts in public policies and unusual surprises, one can suggest that the percentage of each generation completing the high school diploma will reach 85 per cent in the Summer of 1976 on the Nation's 200th birthday. All that is needed is continued growth in real income per person, a continued gradual diminution in more desirable alternatives for the less well schooled 17, 18 and 19 year old population, and, of course, continued diligence in pursuing the educational task this index represents. If the proportion

of Chart 1 continued to increase in the same manner as it has in the past, it would reach 95 per cent by the year 2000.[2]

## Some Future Options

The Nation could, of course, seek to accelerate growth in this ratio. Alternatively, it could turn its attention to other educational matters and cause growth in this ratio to halt altogether. Some of the factors in this process may be illustrated. For example, one might cause acceleration in the growth of average standards of performance which would result in a slower rate of growth in the proportion of each generation completing the diploma than would otherwise be the case. Conversely, standards of performance might be reduced. But such a step would satisfy few; it does not address the educational problem. Few would suggest, for example, that the high school diploma be awarded to all students completing the 10th or 11th grade.[3]

Thus, the particular amount by which the proportion of each generation completing the high school diploma has persistently increased, year after

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[2] The particular function used to depict this alternative future for the ratio of Chart 1 carries an explicit assumption that the amount by which the ratio increases annually will decrease as the ratio approaches 100.

[3] Despite the fact that such a step would not address the educational task, it might nevertheless, work to solve what some perceive as a growing social problem: the use of the diploma to exclude individuals from occupations for which that level of formal education is unnecessary.

year, over the course of the past 70 years might be explained as the result of a compromise between two dominant, powerful and conflicting social forces. On the one hand, the educational system has been faced with a persistent social desire for universal attainment of the high school diploma. On the other hand, it also has been faced with a persistent social need for an ever-increasing level of substantive achievement at each grade level. For example, in at least one suburban school system with a large proportion of high achievers, complaints are beginning to be heard that "the 12th grade is a waste of time." As a result, the educational system has been faced with strong pressures to raise grade-level standards--for those who can handle the additional difficulty with ease--and, at the same time, to avoid raising grade-level standards to avoid excluding those who are newly expected to meet prior standards.

This would seem to be a difficult compromise, indeed. It suggests that the rate at which the system has accommodated an increasing proportion of the age-eligible population has been constrained by the learning process itself, given the compromises required by these two strongly desired, but conflicting social objectives. Each marginal group, newly accommodated at a particular grade level, presumably represents a somewhat lower level of substantive attainment than the average of their more fortunate contemporaries. At the same time, it is entirely possible that each newly accommodated marginal group <u>also</u> represents a level of substantive attainment at least equal to some of their more fortunate predecessors.

Although one may suggest that growth in the proportion of the eligible population completing work for the high school diploma has been constrained by the learning process itself, it is important to repeat that there have been periods when a reduction in the number of acceptable alternatives to completing the diploma has caused the rate of growth to increase (1930's) and periods when an increase in the number of socially desirable alternatives has caused the rate of growth to decline. It is doubtful, for example, that many high school students were compelled to enter the armed forces during the 1940's. Thus, social and economic considerations which might alter the options of students are not irrelevant to this growth process.

The point of this discussion is not simply to make a forecast that, given a function describing the behavior of this ratio over the past 70 years, the proportion of 18-year olds attaining the diploma will reach 85 per cent in the Summer of 1976. Rather, the point is to understand the nature of such growth for the purpose of asking what will be required of the students, the educational system, and society at large if we choose to alter this rate of growth in alternative ways?

## The Undergraduate Level

One can be impressed with the achievement of the elementary and secondary system during the past century and look with some pride on the attainment of a nearly universal system of public secondary school instruction. The

achievement in higher education has been no less impressive. Chart 2 suggests that the percentage of each generation completing a BA level degree has increased from about 2 per cent during the first two decades of the 1900's to about 20 per cent today . [3] [4] This ratio has increased by a factor of 10 in the past 50 years.

The ratio presented is actually the ratio of the number of BA level degrees awarded in a given year to a weighted average of the number of persons in each of 11 age cohorts from age 21 through age 31 on July 1 of each year. For example, a Census Bureau study [5] shows that in October 1965 about 15 per cent of 4th year college students were 20 years old and suggests that about 2 per cent were 30 years of age. Beyond these age limits the number of students accounted for is less than 1 per cent of the total number of 4th year students. Thus, the base for the ratio shown in Chart 2 was constructed to include 15 per cent of the number of 21-year olds on July 1 of the year in which the degrees were awarded and 2 per cent of the number of 31-year olds, together with corresponding percentages of each of the intervening age groups.

This ratio also must be taken only as an index of the proportion of each generation completing the degree. Again, it is the long-term trend which is important.[4] The fact that the value of the ratio for

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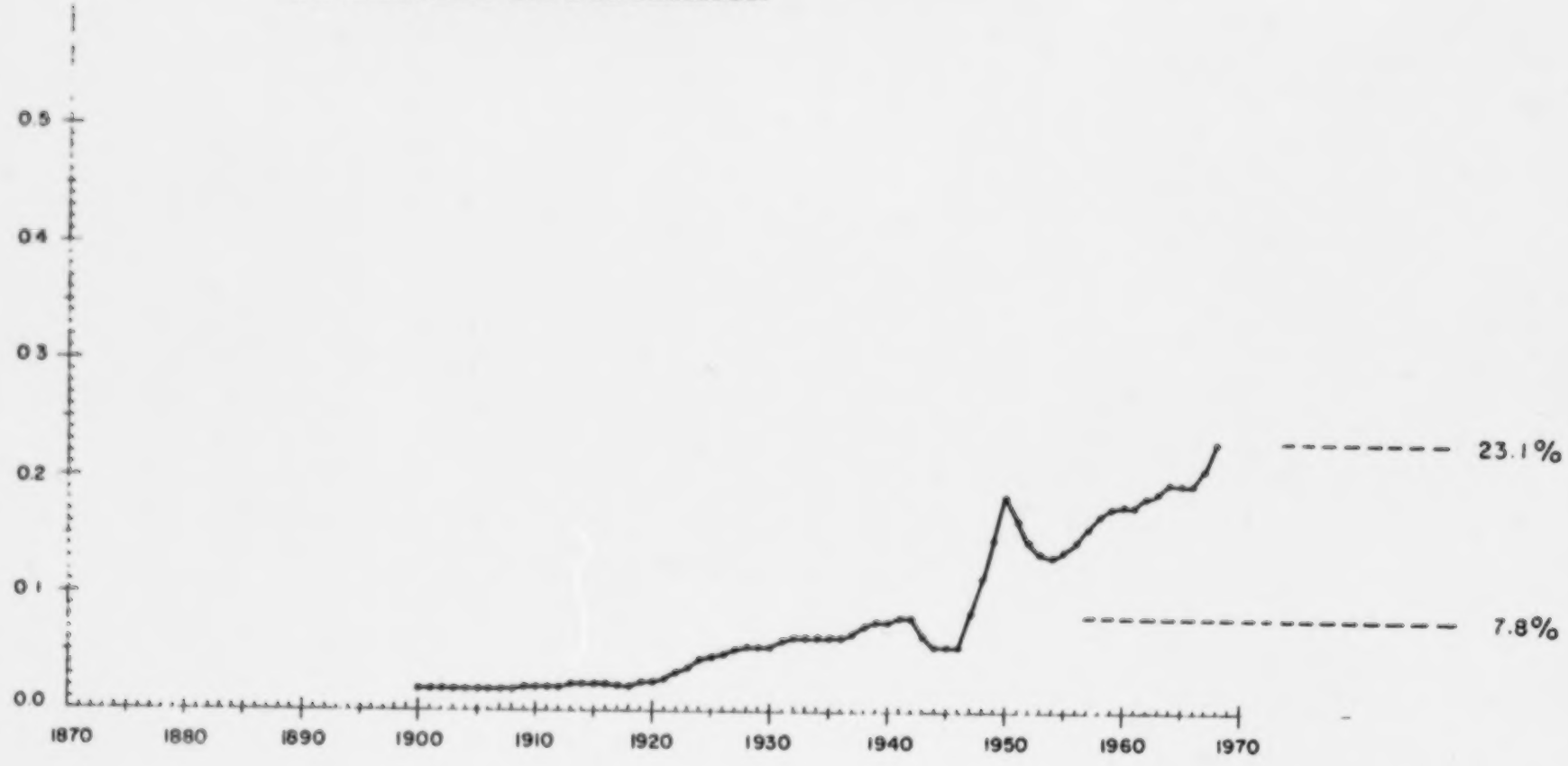
[4] The same qualifications must be attached to the trend of this index as to the one shown in Chart 1. The age distribution of degree recipients has not remained constant over this time period. The proportions of the earlier generations ever completing the degree is likely to be somewhat higher than that shown.

CHART 2

A 10890

## RATIO OF NUMBER OF BA LEVEL DEGREES TO EXPOSED BA POPULATION

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certain specified years departs significantly from the ratio it is intended to represent is of less significance. For example, the ratio for the World War II years and the years of the GI bill are much lower and higher, respectively, than the proportion of those generations who actually completed the degree.

This index suggests that the rate at which each generation has attained the BA level degree has increased by an average of about 3.6 per 1000 annually since 1920. This experience has not been uniform, however. Unlike the proportion of 18-year olds completing high school, this ratio remained below the long-run trend during the depression years as well as the war years. One possible explanation of the depression experience is simply that, relative to the economic and financial needs of students, undergraduate study was subsidized to a lesser extent than elementary and secondary study. Unlike the alternative of continuing one's high school education for 17-19 year olds, entering college was not as attractive an alternative for the 18-30 year olds when employment opportunities declined during the 1930's.

Also, the post-World War II experience for higher education was unlike that of our high schools. The student financial aid granted returning veterans caused many of those who otherwise would have gone to college in the years 1940-46 to take up their academic careers again after the war. Undoubtedly, the aid given veterans also caused some who otherwise would not have gone to college to do so after the war. But, just as

certainly, there were others who would have gone to college but for the combination of an economic depression and a war who later judged their opportunity lost even with the additional financial assistance. On balance, it is a moot question whether the World War II veterans' aid did much more to advance growth in this ratio than compensate for the loss during the war.

The experience for both the 1966-67 and the 1967-68 school years require special attention. In both years a significant rise in the ratio of Chart 2 occurred. This can be explained by the effect of the Higher Education Act of 1965 which made more than half a billion dollars a year available to students in the form of loans and grants. This clearly made it possible for many students to graduate in those years than would otherwise have been the case. However, it is instructive to recognize that the effect of that legislation observed during 1967 and 1968 was necessarily confined to those who were within at least 3 years of graduation at the time the program was authorized. In other words, this result must represent the program's influence on part-time students and students who otherwise would have delayed their studies for a time. Subsequently, other effects of the newer governmental programs of the past years will be discussed.

In assessing the future of post-secondary education, however, one would wish to know more about the relationship between the quantitative output of institutions of higher education and the quantitative output of

the elementary and secondary system, because one is generally accepted to be a prerequisite for the other.

Progression From High School to College

Chart 3 shows the ratio of the number of BA level degrees awarded annually to the number of high school diplomas awarded 5 years earlier. [3] [1] A 5-year lag is chosen simply because, in recent years, the average age on receipt of the BA level degree has been 23 as compared to an average age on receipt of the high school diploma of 18. Neither a 4-year lag nor a 6-year lag, however, makes much difference in the conclusions reached about long-run significance of this ratio.

The important points of Chart 3 are that the ratio of BA level degree recipients to high school graduates fell from somewhere near .75 in 1875 to a level of about .3 where it stabilized during the decade preceding 1913. It then fell to a level of about .2 by 1918. It rose again to a level of just under .3 in the prosperous period during the last half of the 1920's. It fell again during the Depression of the 1930's and the period of World War II. Of course, this index rose well above .3 during the period of the GI Bill. But, it seems to have stabilized following the Korean War at just under .3 where it has remained for the past 10-12 years--again, with the exception of the 1967-68 school year.

CHART 3

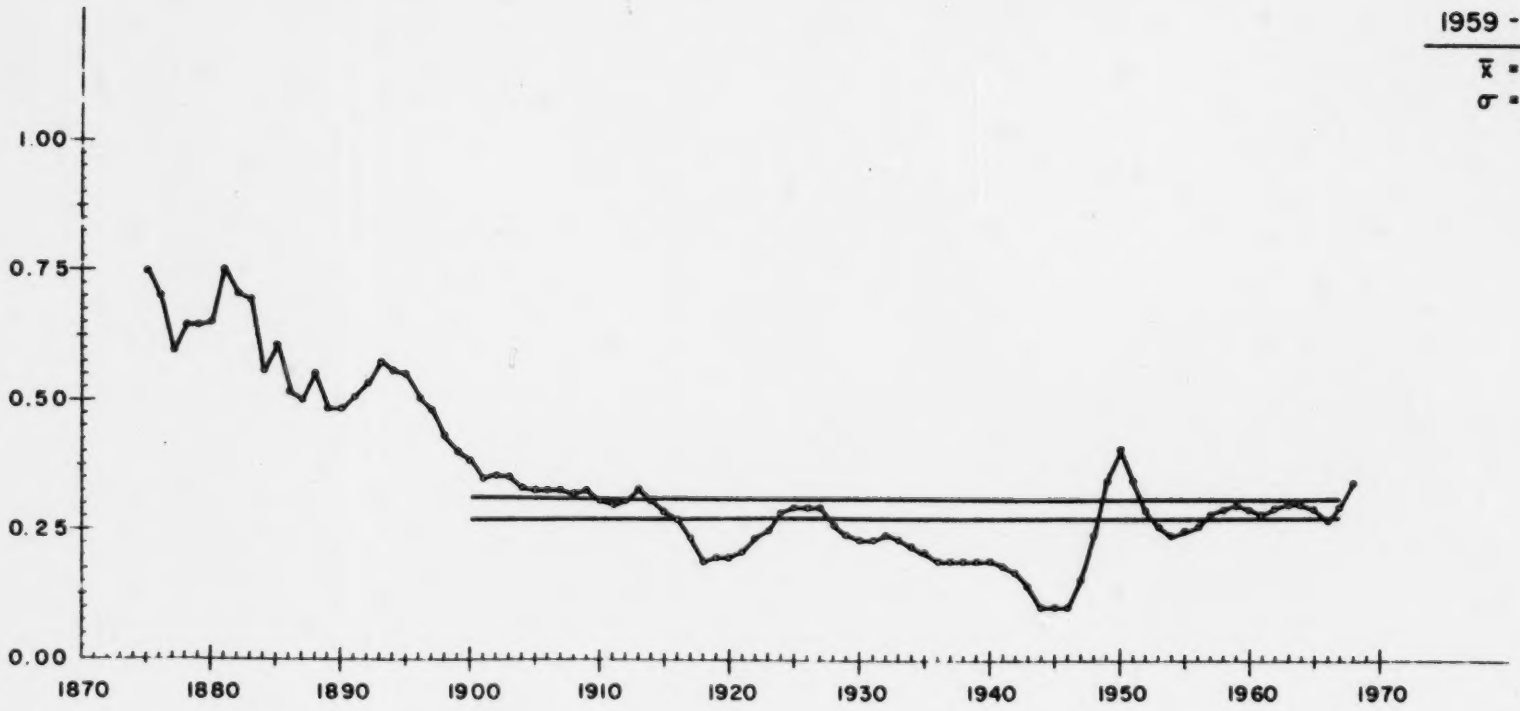
A10894

# RATIO OF THE NUMBER OF BA LEVEL DEGREES TO THE NUMBER OF HIGH SCHOOL DIPLOMAS FIVE YEARS EARLIER

1959 - 1967

$\bar{x}$ = 0.29

$\sigma$ = 0.01

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This relationship does not accord with the widely held belief that there has been a rising propensity for high school graduates to enter and complete college--a view which is a perfectly logical implication of a generally rising level of educational attainment within a homogeneous system of publicly and privately subsidized instruction. But the American instructional system has not developed in such a manner.

During the last third of the 19th Century the groundwork was being laid for a massive new system of public instruction. This period saw the origin and development of the land-grant colleges at the same time the goal of universal secondary education began to be placed in effect. While higher education began to encompass a wider and wider variety of subject matter--following the clearly expressed intention of the land-grant college movement--the secondary schools were producing a growing proportion of high school graduates within a population of young people which itself was growing at a rapid rate. This growth in school age children was the result of both a growing number of births and a significant immigration. Higher education was unable to hold its own in producing roughly proportionate numbers of BA degrees within each new wave of high school graduates. Thus, from 1870 to 1900 the number of 18-year olds almost doubled while the annual number of high school graduates increased 6 times and the annual number of BA's awarded increased a little more than three-and-a-half times.

Following 1900, however, with the exception of wars, depressions, and the effort following World War II to compensate for the educational

losses of a war, institutions of higher education apparently have tended to graduate a stable percentage of high school graduates relative to the last 30 years of the 19th century.

Furthermore, as Chart 4 shows, the ratio of BA level completions to undergraduate enrollment has also been remarkably stable over this same period. [3] [6] The gradual, but perceptible, long-run rise in this ratio might be attributed to a shorter average time in college--a reduction in part-time and intermittent college work--rather than to any fundamental change in the ratio of those ever completing to those starting the BA level process. Whatever its cause, neither does this result accord with what one might expect within the context of a rising average level of educational attainment produced within a single homogeneous system of instruction.

Chart 5 offers additional evidence of the behavior of the ratio of completions to starts in four-year degree-credit programs. [3] [7] Information on first-time enrollees has been available only since 1939, but the data suggest that for the period of the last 10 years, at least, about 46 per cent of those starting the BA process have not completed the degree. From 1950 to 1960, this indicator suggests a decline in the completion ratio. Because of the influence of returning veterans following World War II, the experience for the earlier decade from 1940 to 1950 is difficult to interpret. However, the data of Charts 4 and 5 suggest a gradual decline

CHART 4

D10409

# RATIO OF NUMBER OF BA LEVEL DEGREES TO TOTAL UNDERGRADUATE ENROLLMENT THREE YEARS EARLIER

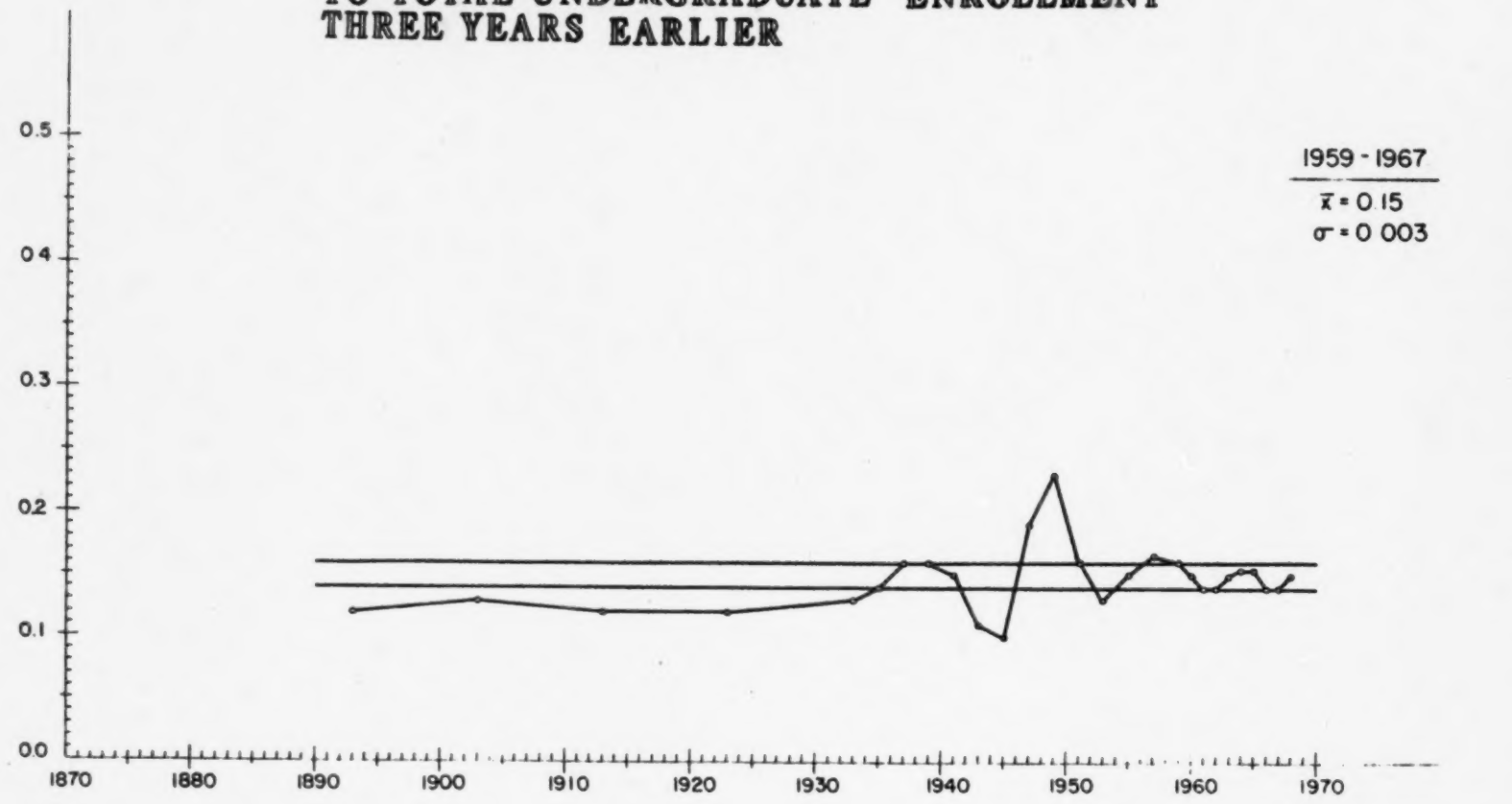


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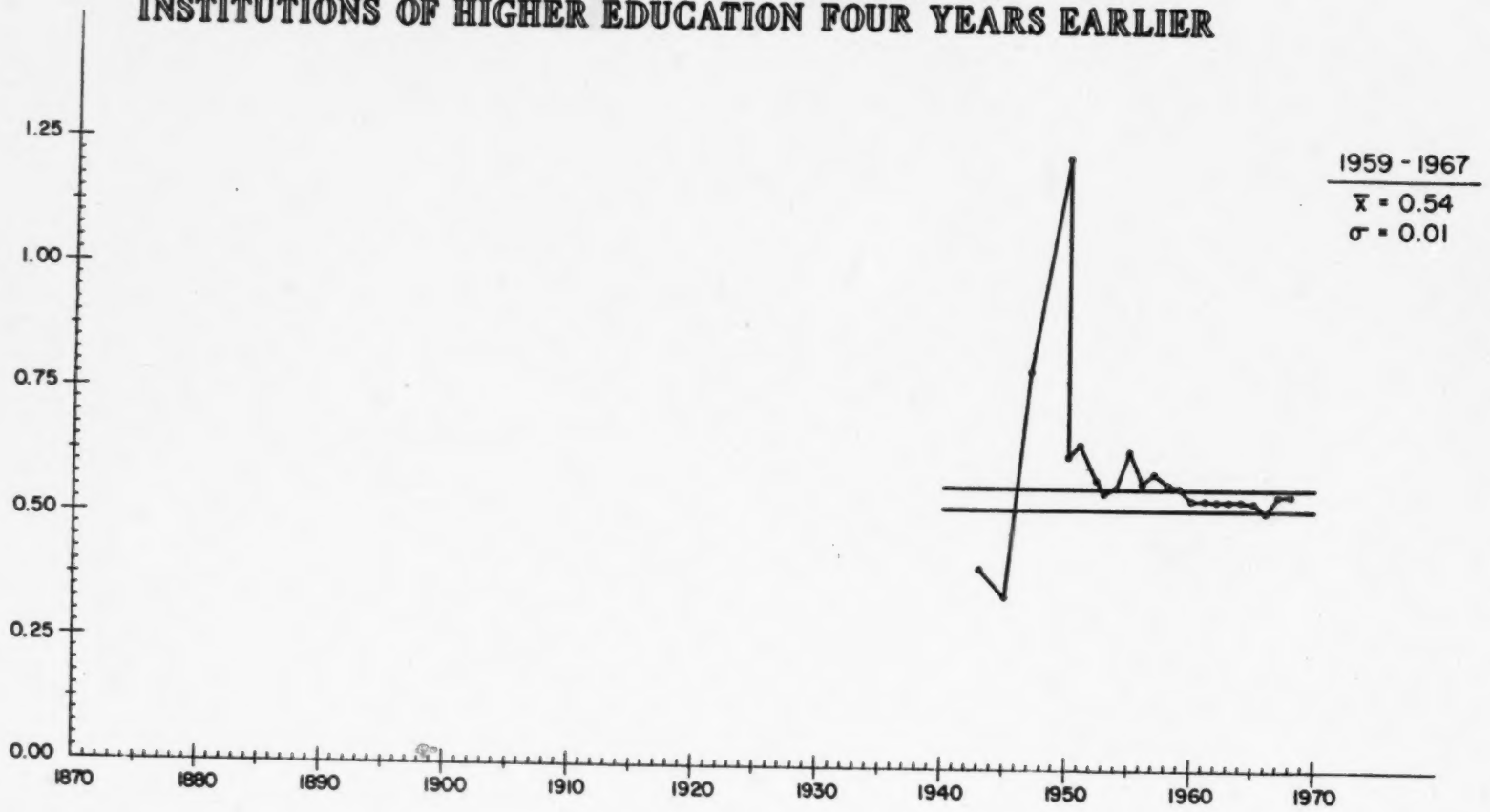
CHART 5

## NUMBER OF BA LEVEL DEGREES AS A RATIO TO THE NUMBER OF FIRST-TIME DEGREE-CREDIT ENROLLEES IN INSTITUTIONS OF HIGHER EDUCATION FOUR YEARS EARLIER



in the completion ratio from about 1950 to 1960 following a longer-term gradual rise in this ratio from the turn of the century.

The long-run trend in the ratio of those starting the college process to those completing high school can be inferred from the material shown in Chart 6. This chart shows the ratio of undergraduate enrollment in the indicated year to the number of high school graduates two years earlier. [6] [1] Because of the more stable pattern of completions to starts as reflected in the ratio of Chart 4, one would expect this ratio to follow the general pattern of the ratio of college completions to high school completion as shown in Chart 3. The ratio of Chart 3 is simply the product of the ratios shown in Charts 4 and 6 with an appropriate time lag.

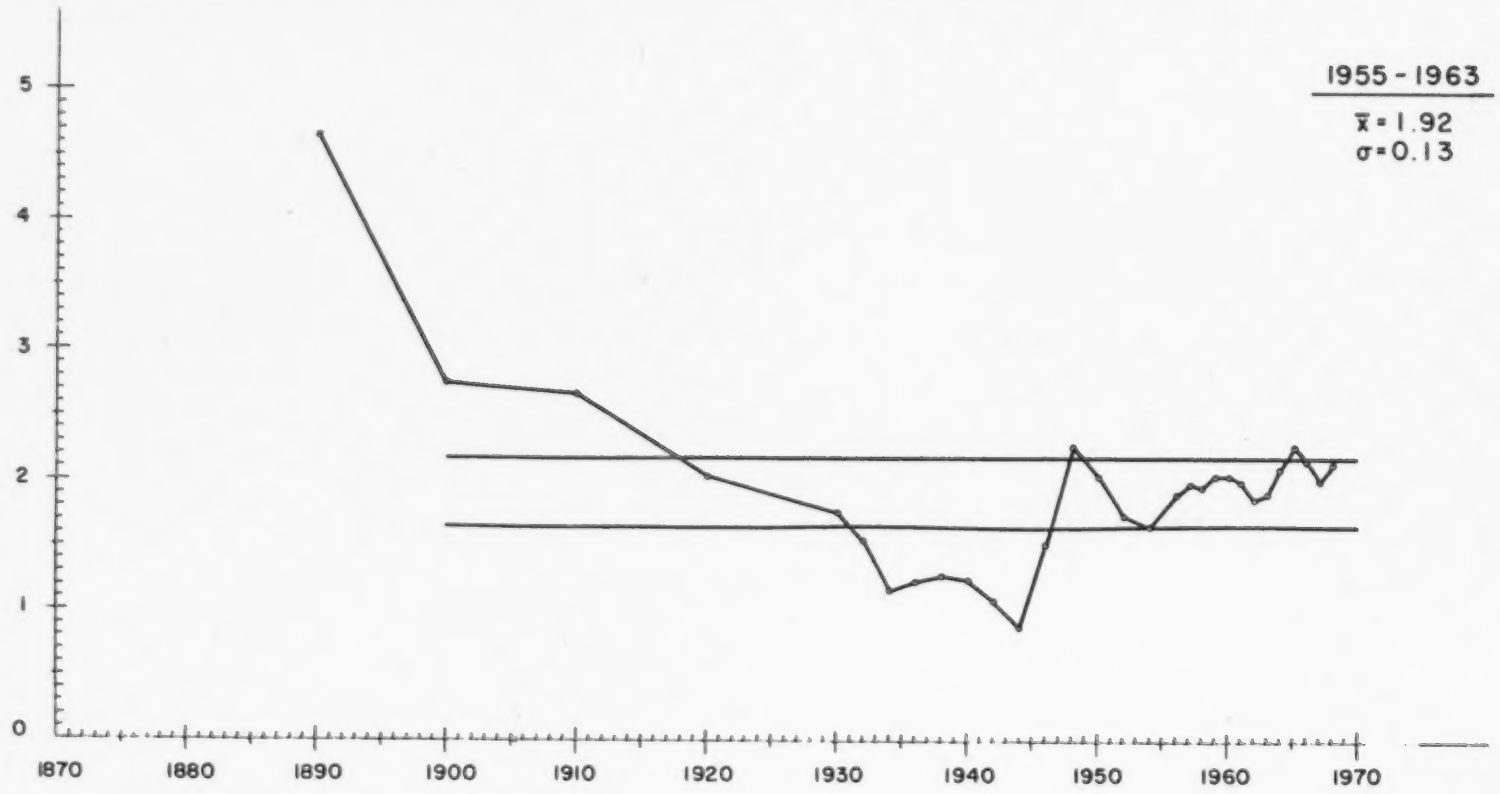
This chart suggests that the general decline in the proportion of high school graduates entering and completing college extended from the late 19th century well into the mid-1930's. But, subsequent to World War II, the proportion entering the 4-year process began a gradually rising trend.

The more recently available material of Chart 7, shows the number of first-time degree-credit students as a ratio to the number of high school graduates one year earlier. [7] [1] This material suggests a gradually rising trend in the proportion of high school graduates who enter degree-credit college programs, dating from the end of World War II. However,

CHART 6

D10410

## TOTAL UNDERGRADUATE ENROLLMENT AS A RATIO TO THE NUMBER OF HIGH SCHOOL GRADUATES TWO YEARS EARLIER




1955 - 1963

$\bar{x} = 1.92$

$\sigma = 0.13$

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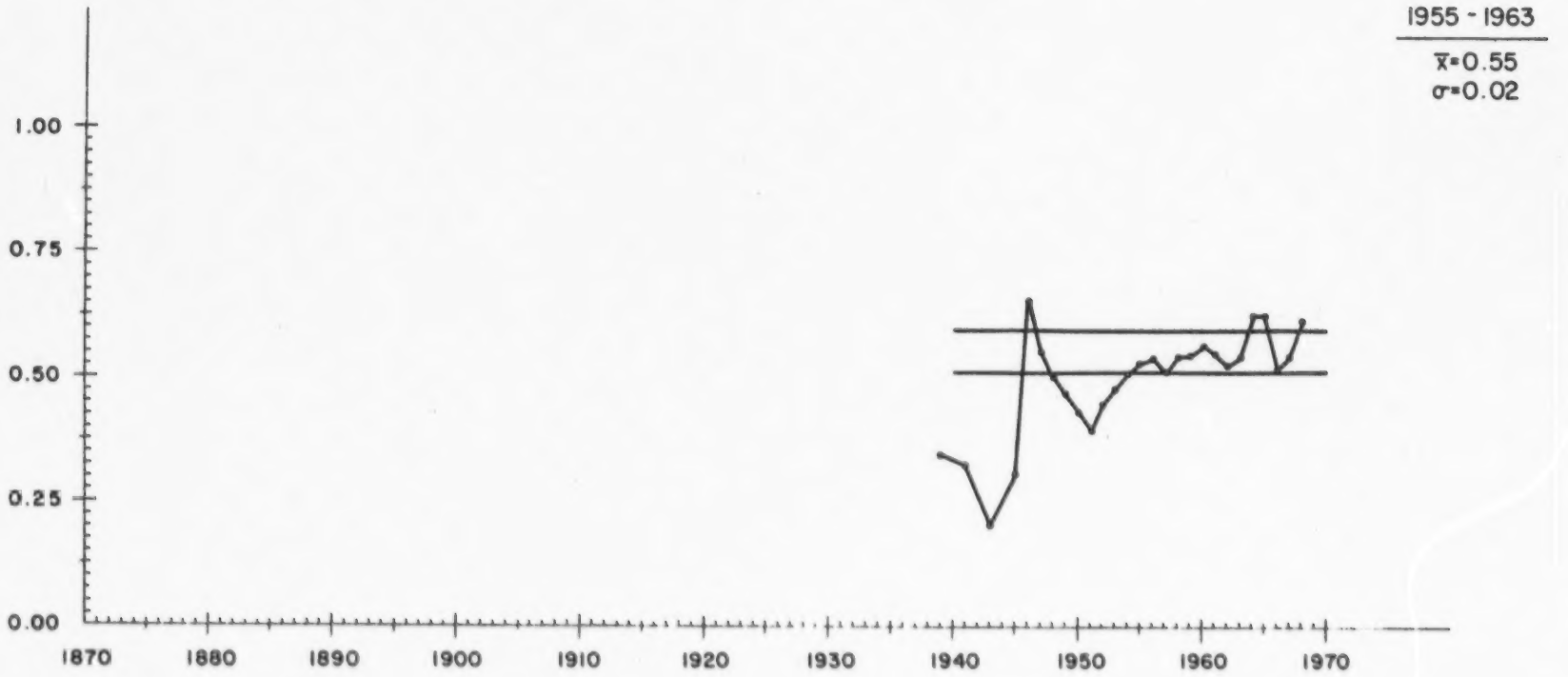
CHART 7

# NUMBER OF FIRST-TIME DEGREE-CREDIT ENROLLEES IN HIGHER EDUCATION AS A RATIO TO THE NUMBER OF HIGH SCHOOL GRADUATES ONE YEAR EARLIER

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this rising trend has also been offset by a gradually falling trend in the proportion completing the process dating from about 1950 when the first post-war freshman classes might have been expected to complete the undergraduate process. Thus, the stimulus given to the entry rate following World War II was apparently accompanied by a decline in the completion rate. The entry rate has continued its gradually rising course since 1950. As stated earlier, the completion ratio seems to have been quite stable in the 1960's.

Later, evidence will be offered to suggest that this phenomenon of a falling completion rate associated with a rising entry rate in the post-secondary system might be an expected result of any significant attempt to increase the rate of growth in the proportion of individuals passing through the system. There is reason to expect that the completion rate would fall before it began to rise following an effective effort to increase the rate of growth in the system.

Another Source of Data

These time-series data, derived from institutional reports to the U. S. Office of Education, exhibit considerable variability from year-to-year and, at the post-secondary level at least, are subject to significant influences on individuals beyond the age of 18 which affect the timing of college experience as well as the ultimate rates at which individuals complete given levels. While such influences are not irrelevant to an

understanding of the process of growth in the instructional system, one would wish to abstract from matters of timing. To do this requires the use of Census material on specific age cohorts.

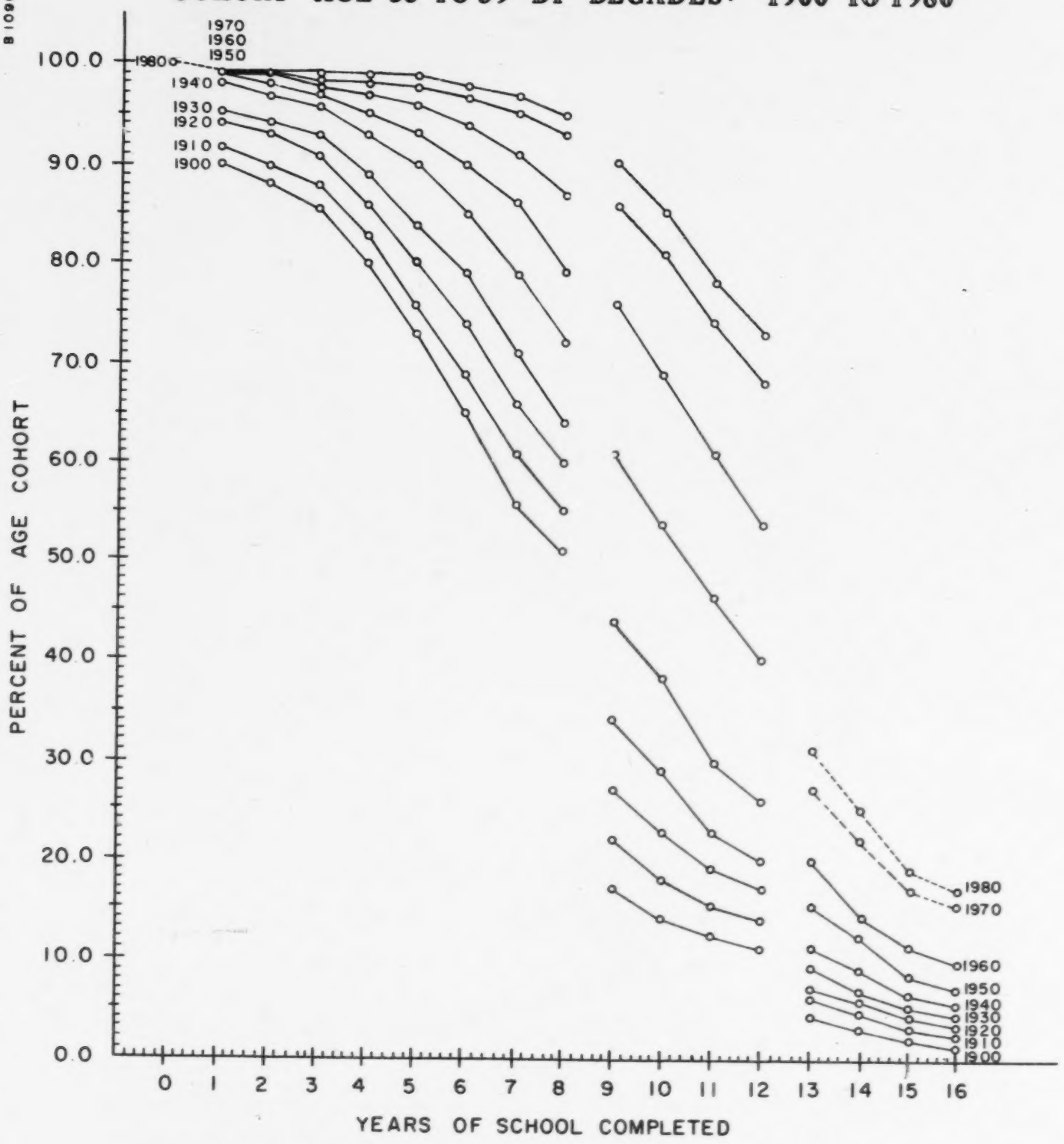
The manner in which the elementary, secondary and post-secondary components of the instructional system have developed during the 20th century can be seen in Chart 8. Illustrated are data from the Decennial Census reports for 1940, 1950, 1960 and a Census survey of 1968 [8] showing the percentage of individuals at each decade who completed specified number of years of school. Prior to 1940, the material reflects the experience of those age groups in 1940 who were age 35-39 in 1930, 1920, 1910 respectively, and 75 and over in 1900. The 1968 age group 30-34 was used to estimate the experience of 35-39 year olds in 1970. The 1968 age group 25-29 was used to estimate the experience of the 35-39 year olds in 1980 for grades 1-12. The post-secondary experience for this latter group is a projection based upon the data of Charts 5 and 7.

The discontinuous manner in which the three segments of the instructional system have been developed is clearly apparent. Neither the secondary component, school years 9-12, nor the higher education component, years 13-16, have developed as parts of a homogeneous instructional system. Historically, the rates at which each generation has progressed from one year to the next in the system have been discontinuous at year 9 and year 13. However, the discontinuity between year 8 and year 9 has been progressively eliminated. The 14 year olds of about 1955 continued on from grade 8 to

CHART 8

B 10900

## YEARS OF SCHOOL COMPLETED FOR POPULATION COHORT AGE 35 TO 39 BY DECADES: 1900 TO 1980



grade 9 at a rate consistent with a systematically continuous function.[5] But the discontinuity between years 12 and 13 has remained.

The question arises: To what extent does the Census material recording the experience of 35-39 year olds at the beginning of each decade reflect the time series relationships exhibited earlier? Table 1 is derived from the material shown in Chart 8.

Table I

Ratios Derived from Years of School Completed by Population Cohorts Age 35-39 by Decades 1900-1980*

| (1) Year of age 35-39 | (2) Years of age 18 | (3) Years of age 23 | (4) Ratio: Year 9 / Year 8 | (5) Ratio: Year 12 / Year 9 | (6) Ratio: Year 13 / Year 12 | (7) Ratio: Year 16 / Year 13 | (8) Ratio: Year 16 / Year 12 |
|---|---|---|---|---|---|---|---|
| 1900 | 1879-1883 | 1884-1888 | .34 | .67 | .42 | .46 | .19 |
| 1910 | 1889-1893 | 1894-1898 | .40 | .65 | .45 | .45 | .20 |
| 1920 | 1899-1903 | 1904-1908 | .46 | .63 | .43 | .45 | .19 |
| 1930 | 1909-1913 | 1914-1918 | .53 | .61 | .45 | .45 | .20 |
| 1940 | 1919-1923 | 1924-1928 | .62 | .60 | .44 | .46 | .20 |
| 1950 | 1929-1933 | 1934-1938 | .79 | .66 | .38 | .47 | .18 |
| 1960 | 1939-1943 | 1944-1948 | .88 | .72 | .36 | .49 | .18 |
| 1970 | 1949-1953 | 1954-1958(P) | .94 | .79 | .40 | .55 | .20 |
| 1980 | 1959-1963 | 1964-1968(P) | .95 | .81 | .43** | .54** | .23** |

* As shown in Chart 8

** Projection based upon data of Chart 5 and Chart 7

(P) Preliminary estimate as described in text

The ratio shown in column (4) of Table 1 shows the rate at which the structural discontinuity between the elementary and secondary segments of the system has

[5] As shown in Chart 8 for the expected experience of 35-39 year olds in 1980.

been progressively closed over the 80 year period. During this same period the structural discontinuity between the secondary and higher education segments, as reflected by the ratio of column (6), remained and, in fact, became more pronounced during the 1930's and 1940's.

It is interesting to note, however, that in the process of bringing the 9th grade completion rates up to a level consistent with elementary school experience, completion rates between year 9 and year 12 (column 5) actually fell between 1880 and 1920. (This is to say, the proportion of each generation completing grade 9 increased at a faster rate than the proportion completing grade 12.) It is possible, therefore, that should the discontinuity between the post-secondary and secondary segments of the instructional system begin to close, completion rates between year 13 and year 16 might be expected to fall before a rising trend develops.

One would expect that the ratios shown in column (7) would exhibit a long-run pattern of change similar to the ratio shown in Chart 4 and a level approximately similar to that of Chart 5. Namely, a long-run stability with perhaps a gradually rising trend to a level of about .54. This seems to be the case, with the exception of the observations for the years prior to 1930. But these earlier observations were all derived from material obtained during the census enumeration of 1940. They reflect the experience of individuals who were in fact 55-59, 65-69, and 75 and over, respectively, in 1940. Thus, these results are subject to considerably more error than the results for later years taken from sequential census reports.

For example, to the extent that mortality rates are inversely correlated with the level of educational attainment, then one would expect that ex post measurement of educational experience would tend toward current experience under conditions of a generally rising rate of educational attainment. Thus, it is more likely that there has been a slow, but persistent rise in the ratio of college completions to starts until 1950 with a reduction in the ratio between 1950 and 1960. Thus, the data of column (7) are not necessarily inconsistent with the ratios of both Charts 4 and 5 described earlier.

One would also expect the ratio shown in column (6) of Table 1 to exhibit a long-run pattern of change similar to that shown in Chart 6 and a general level of the ratio of Chart 7. The pattern of change is similar. A general decline in the ratio during the 1930's and 1940's followed by a rise to the prior level of the 1920's. The expected decline from the late 19th century is not apparent. But, again, one cannot say what the Census of 1900 might have shown had questions been asked regarding the number of years of school completed in that year.

The level of the ratio shown in column (6) is about 10 per cent lower than the level of the ratio shown in Chart 7. However, it is known that the reports of household respondents to Census enumerators are subject to a significant degree of reporting error. In 1960 the proportion of the population age 25 and over reporting at least 12 years of school completed was found to be overstated by about 6 per cent.[6] Also, there is a definitional

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[6] See: U.S. Bureau of the Census. Current Population Reports, Series P-20, No. 182, U.S. Government Printing Office, Washington, D.C., April 28, 1969.

problem. The term "12 years of school" is not likely to be equivalent to "high school graduation" for all respondents to the Census.

In Chart 8 a clear peak can be seen at school years 8, 12, and 16. This suggests the possibility of a net overstatement of some degree at these years.[7] Thus, it is entirely possible that the level of the ratio shown in column (6) of Table 2 could differ from that of Chart 7 due to reporting error and definitional differences in the Census data on one hand and variations of timing in the ratio of Chart 7 on the other. The proportions of the population reporting the completion of years 13 through 16 are significantly smaller than the proportion completing year 12 and are thus subject to a smaller amount of reporting error. In addition, the meaning of 13 or 16 years of "regular" school, as defined by the Census, is likely to be much closer to the concepts used by institutions of higher education in reporting degree-credit work to the U.S. Office of Education. This would tend to explain why the level of the ratio of column (6) is lower than that of Chart 7 while the level of the ratio of column (7) is in much closer agreement with the ratio of Chart 5.

One would expect the ratio of column (8) of Table 1 to agree with the level and general pattern of change of the ratio shown in Chart 3. The pattern of long-run stability is apparent with a decline during the mid 1930's and 1940's. However, the level of the ratio is about 9 per cent

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[7] However, it is also probably true that our society attaches a special value to the completion of years 8, 12, and 16 which is not carried by the completion of other amounts of schooling.

lower than that of Chart 3. Again, the difference between the Census reports and the institutional reports could account for this discrepancy in level. Also, the marked decline in the ratio of Chart 3 during the 19th century is not apparent in the Census data collected in 1940 and for those earlier generations. The general pattern for the observations for 1940 forward, however, is in reasonable agreement with the data of Chart 3.

Summary: Years 1-8

The elementary, secondary and higher education components of the instructional system in the United States have been developed as largely independent segments.

During the course of the past 90 years the elementary system has grown at a faster rate than the number of school age children, raising the proportion of each generation completing the 8th grade from about 51 per cent of those who were age 14 in 1877 to an expected completion rate of about 97 per cent of those who were age 14 in 1967. The proportion completing each incremental year from grade 1 through 8 has tended to follow a continuous and largely predictable function for each generation. Rates of attrition at each grade level have persistently decreased from one generation to the next.

Summary: Years 9-12

The secondary system, comprising grades 9 through 12, has grown at a faster rate than the elementary system during the past 90 years, raising the proportion of each generation completing the 12th grade from roughly 5-10 per cent of those who were 18 in 1880 to an expected rate of about 80 per cent of those who were 18 in 1970.

Notwithstanding the fact that roughly 20 per cent of today's 18-year old population will not be expected to complete the 12th grade, the structural discontinuity between the elementary system and the secondary system, which was in striking evidence in the late 19th century, and which remained during the first half of the 20th century, largely has been eliminated. Between 1950 and 1960 the attrition rate between grades 8 and 9 became a largely predictable and continuous function of attrition rates within the elementary system. Subsequently, this maturation was extended to grades 10, 11 and 12.

Following the decade of 1960, the proportion of each generation completing each incremental year from grade 9 through grade 12 may be expected to follow a continuous and largely predictable function of prerequisite experience for each generation.

Between 1880 and about 1925, the rate of attrition between grade 9 and 12 actually increased. Beginning about 1925, however, rates of

attrition at each grade level have decreased from one generation to the next. Because the secondary system has only recently reached a state of maturity with respect to the elementary system in this respect, the future rate of growth in the proportion of each generation completing the 12th grade may be expected to slow. In the future this proportion will be essentially a function of the proportion of each generation completing prior levels.

Summary: Years 13-16

What we describe today as higher education (more appropriately, the tertiary system), comprising grades 13 through 16, has grown at approximately the same rate as the secondary system during the past 85 years. The proportion of each generation completing the 16th year has increased from less than 2.3 per cent of those who were 23 years old in 1885 to an expected rate of about 20 per cent of those who were 23 years old in 1969. By and large, the structural discontinuity between the secondary and tertiary system which existed at the turn of the century still exists today. The same attrition rate between year 12 and year 16 which existed at the turn of the century was still in evidence as late as 1968.

Institutional data on enrollment and degrees awarded in higher education, in relation to the number of high school diplomas awarded annually, suggest that attrition between grades 12 and 13 actually increased (proportion

entering college fell) from 1870 until the end of World War I. This attrition rate then diminished (proportion entering college rose) during the 1920's. With the onset of the depression of the 1930's, attrition from grade 12 to grade 13 increased again following a trend which lasted until the end of World War II. Available evidence suggests that this attrition has diminished since that time. Entry rates from high school to college have been rising in recent years. But, the proportion of high school graduates who enter college stands at about the same level today as in 1920 and at the turn of the century.

The rate of attrition between grades 13 and 16 apparently followed a gradually falling trend throughout the 20th century until about 1950. From 1950 to about 1960, however, with the advent of a rising rate of high school graduates entering college at the end of World War II, attrition from year 13 to year 16 increased. For the past 10 years the rate at which beginning degree-credit students have completed a four-year degree has been virtually constant at about 54 or 55 per cent.

On net balance, the experience for the tertiary grades 13 through 16 has been such that the proportion of high school graduates who complete a four-year degree has been virtually constant since the turn of the century with the exception of the depression period of the 1930's and the World War II period of the 1940's, for which generations this rate of attainment declined. The experience for the 23 year olds of 1968 is essentially in

line with these statements, but their full exposure to college will not be complete for another 10 years at least. One may therefore assume that this state of affairs may be changing.

## Some Recent Institutional Changes

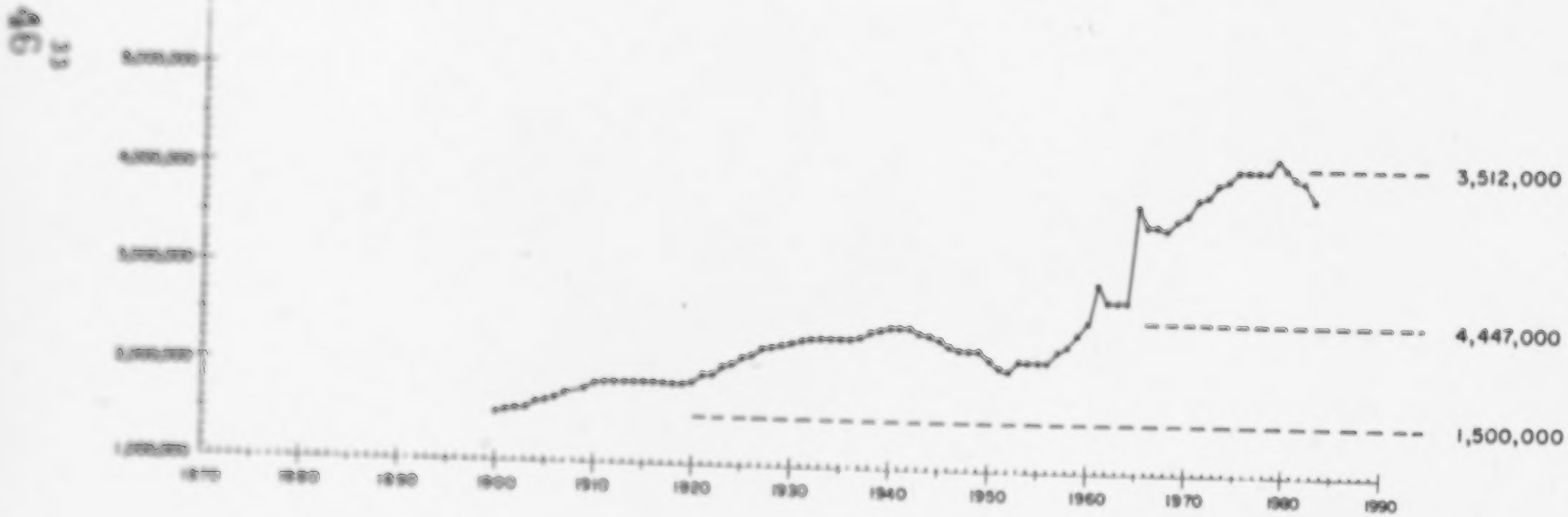
Notwithstanding the historical stability of the proportion of high school graduates completing college, the number of 18-year olds in the population has increased by a factor of about 1.7 since the end of World War II. [2] As shown in Chart 9, a significant increase in the number of 18-year olds occurred in the mid-1960's when the post-war babies reached the age of 18. Also, as has been described, the proportion of 18-year olds completing high school increased by a factor of more than 1.5 since the war period. This resulted in an increase by a factor of more than 2.6 in the number of individuals eligible for post-secondary instruction, with much of this increase occurring after 1965.

At the beginning of the post-war period most of the institutions of higher education in the United States were more than 50 years old and well established. The established campuses, having dealt with the over-capacity enrollments of returning veterans by 1950, began to reach the practical limits to their size in the early 1960's. Since then, the established institutions have understandably responded to pressures to grow further partly by raising entrance requirements, raising tuition, and otherwise limiting enrollment. New campuses were required.

CHART 9

A10893

## POPULATION 18 YEARS OF AGE : 1900 – 1986
JULY 1



Possibly the most significant change in the institutional structure of the tertiary system to occur since the formation of the land grant colleges during the late 19th century is the recent growth in the number of two-year colleges. With the implementation of the Higher Education Facilities Act of 1963 and the Higher Education Act of 1965 the establishment of new four-year campuses and new community colleges was greatly accelerated. Between the Fall of 1965 and the Fall of 1968 there was a net increase in the number of two-year institutions of 185. The number of four-year institutions increased by 67 and the number of universities increased by 5.

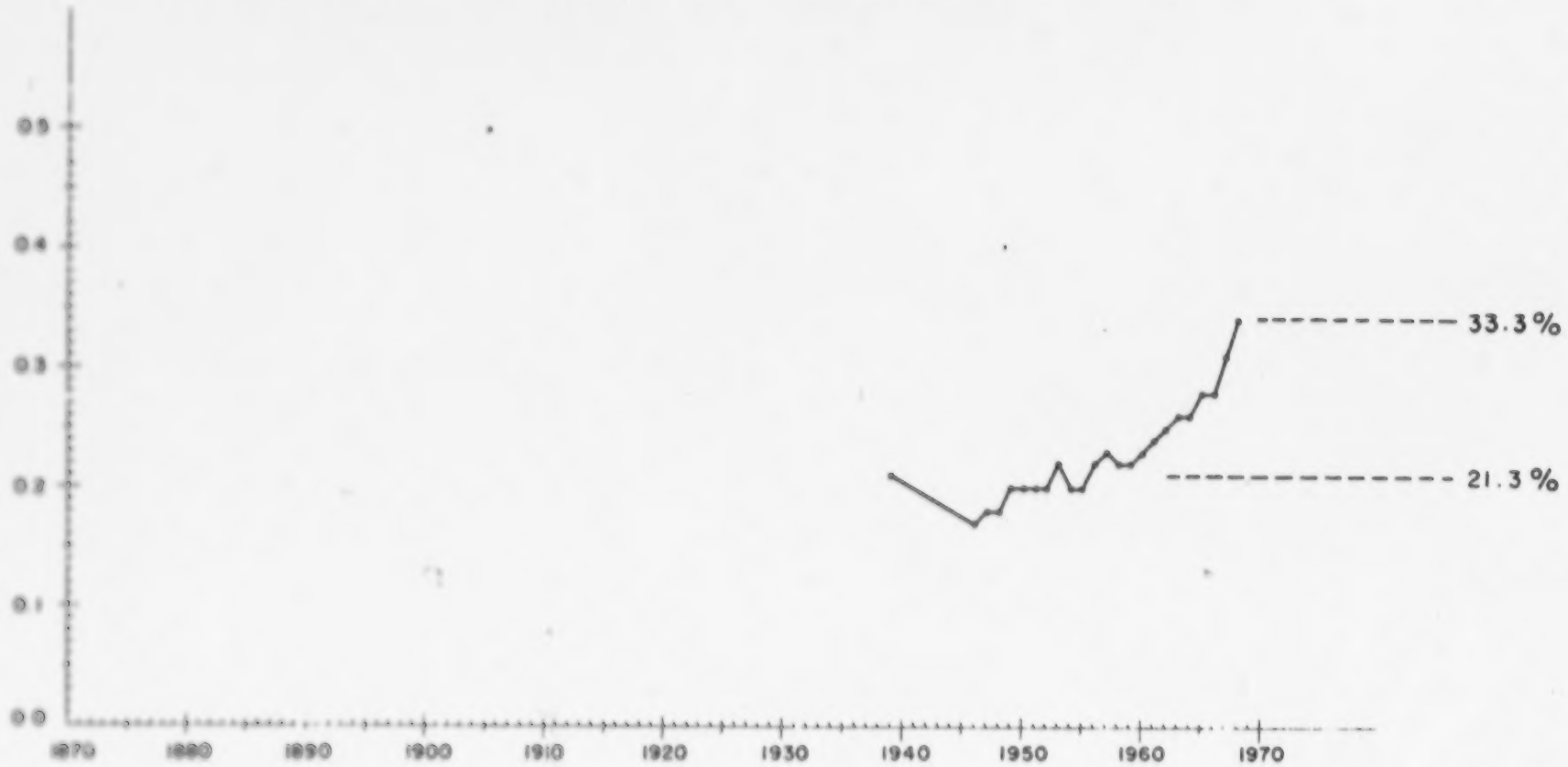
Chart 10 shows that, in the course of this change, the proportion of first-time four-year degree-credit students who enter two-year institutions has risen from about 20 per cent in 1950 to more than one-third today. [7] It is a matter of no little interest to compare this result with the degree-credit completion ratio shown earlier in Chart 5. Specifically, while the proportion of Chart 10 increased from 20 per cent in 1954 to 27 per cent in 1963, the completion ratio 5 years later remained essentially unchanged at 54 per cent from 1959 to 1968.

Thus, in addition to providing new opportunities for tertiary instruction outside the traditional four-year programs, the new community colleges are also assuming a significant and growing share of traditional lower division instruction.

CHART 10

A 10869

# RATIO OF FIRST-TIME DEGREE-CREDIT ENROLLMENT IN TWO YEAR INSTITUTIONS TO FIRST-TIME DEGREE-CREDIT ENROLLMENT IN ALL INSTITUTIONS - HIGHER EDUCATION

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There are three reasons for believing that this development represents as significant a change in the institutional structure of traditional degree granting programs (even within the context of a constant proportion of high school graduates completing the BA level degree) as it probably does for less traditional tertiary non-degree programs.

The first reason is purely empirical. If the completion rate for four-year degree programs rises for those entering two-year institutions, relative to the completion rate for those entering four-year institutions, then it is clear that some share of the task of traditional lower-division instruction is being assumed by the newer institutions. While the empirical evidence on this point is not unambiguous, data published by the American Council on Education show that the proportion of freshmen entering two-year colleges with an average high school grade (self-assessed) of B+ or better decreased less than proportionately between the Fall of 1966 and the Fall of 1969. The proportion of freshmen reporting an average high school grade (self-assessed) of C or below actually declined at two-year colleges as compared with an increase in this proportion for all institutions combined. This result is shown in Table 2.

Table 2

Percentage of Freshmen Reporting an Average High School Grade of:

B+ or Better

| | Fall of 1966 | Fall of 1969 | Difference |
|---|---|---|---|
| All Institutions | 32.4 | 28.1 | -4.3 |
| University | 42.9 | 40.2 | -2.7 |
| 4-Year College | 37.4 | 36.4 | -1.0 |
| 2-Year College | 10.7 | 10.3 | -0.4 |

C or D (omitting C+)

| | | | |
|---|---|---|---|
| All Institutions | 14.4 | 15.6 | +1.2 |
| University | 7.4 | 7.5 | +0.1 |
| 4-Year College | 10.1 | 8.8 | -1.3 |
| 2-Year College | 30.5 | 28.6 | -1.9 |

Source: American Council On Education, National Norms For Entering College Freshmen, Fall 1966 and Fall 1969.

Second, to suggest the contrary--that this growth in community colleges is exclusively devoted to serving those who would otherwise terminate their formal instruction at some point short of a four-year degree--is to suggest that some selection process (including the possibility of self-selection) exists which permits an effective ex ante prediction as to who will and who will not successfully complete a four-year program.

The available evidence suggests very strongly that no such selection process exists.[8]

Third, if this growth in community colleges effectively reduces the cost to individuals of lower-division instruction, it could be expected to increase the demand for upper division instruction ( and eventually graduate instruction), assuming no off-setting increases in the cost at higher levels, even under circumstances which produce a decline in the ratio of completions to starts in four-year programs. A reason for this is very simply stated. An increase in the proportion of an age cohort completing any given number of units of instruction, say n, may be viewed as also increasing the proportion of that cohort eligible for unit n + 1. And, for any society in which the amount of instruction one has completed imparts some special advantage over one's contemporaries with less (or is believed to so impart), then a strong social desire for a continuously growing system is likely to result. As evidence of this possibility, one is referred again to Chart 8 and Table 1 describing the experience of growth in the secondary system between 1875 and 1915.

The Graduate Level

The proportion of the total number of degrees of all types awarded annually which are accounted for by graduate level degrees has risen from

[8] For example, see: Levin, David E., The Prediction of Academic Performance, New York: Russell Sage Foundation, 1965.

about 6 per cent in 1910 to about 20 per cent in the Summer of 1968. [3] [9] [10] Census material shows that more than 5 per cent of those who were age 30-34 in 1968 completed 5 or more years of college. Data on advanced degrees awarded when related to the approximate size of population cohorts involved at that level suggest that more than 5 per cent of today's generation will complete at least the MA level degree.

Chart 11 shows that the ratio of MA level degrees awarded annually to the number of BA level degrees awarded two years earlier has been progressively increasing since at least 1910. [9] [3] This ratio is now at a level of more than .25, suggesting that more than one out of every 4 college graduates completes an advanced degree. There is no evidence to suggest that growth in this ratio will decline.

This experience strongly suggests a proposition worth testing further: That attrition rates from year 16 to years 17, 18 and subsequent levels of instruction may be continuous and usefully predictable functions of prior attainment. There is some incomplete evidence, not presented here because of its tenuous nature, that the discontinuity which has been apparent at school years 9 and 13 may not have occurred to the same degree at year 17. If this proves to be the case, it would mean that the future size of classes beyond year 16 may be determined largely by the extent to which the present discontinuity between year 12 and 13 is closed, and the attrition rate within the tertiary system of the future. This also would depend, of course, upon the future structure of costs and the institutional policies

CHART 11

A10891

# RATIO OF THE NUMBER OF MA LEVEL DEGREES TO THE NUMBER OF BA LEVEL DEGREES TWO YEARS EARLIER

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concerning financing and enrollment. Without further analysis, one may only point out that the behavior of the ratio shown in Chart 11 is very much what one would expect from a generally rising level of educational attainment within a homogeneous system of instruction beyond year 12. That is, the data imply a continuously falling rate of attrition between any two levels of the system from one generation to the next.

Expenditures

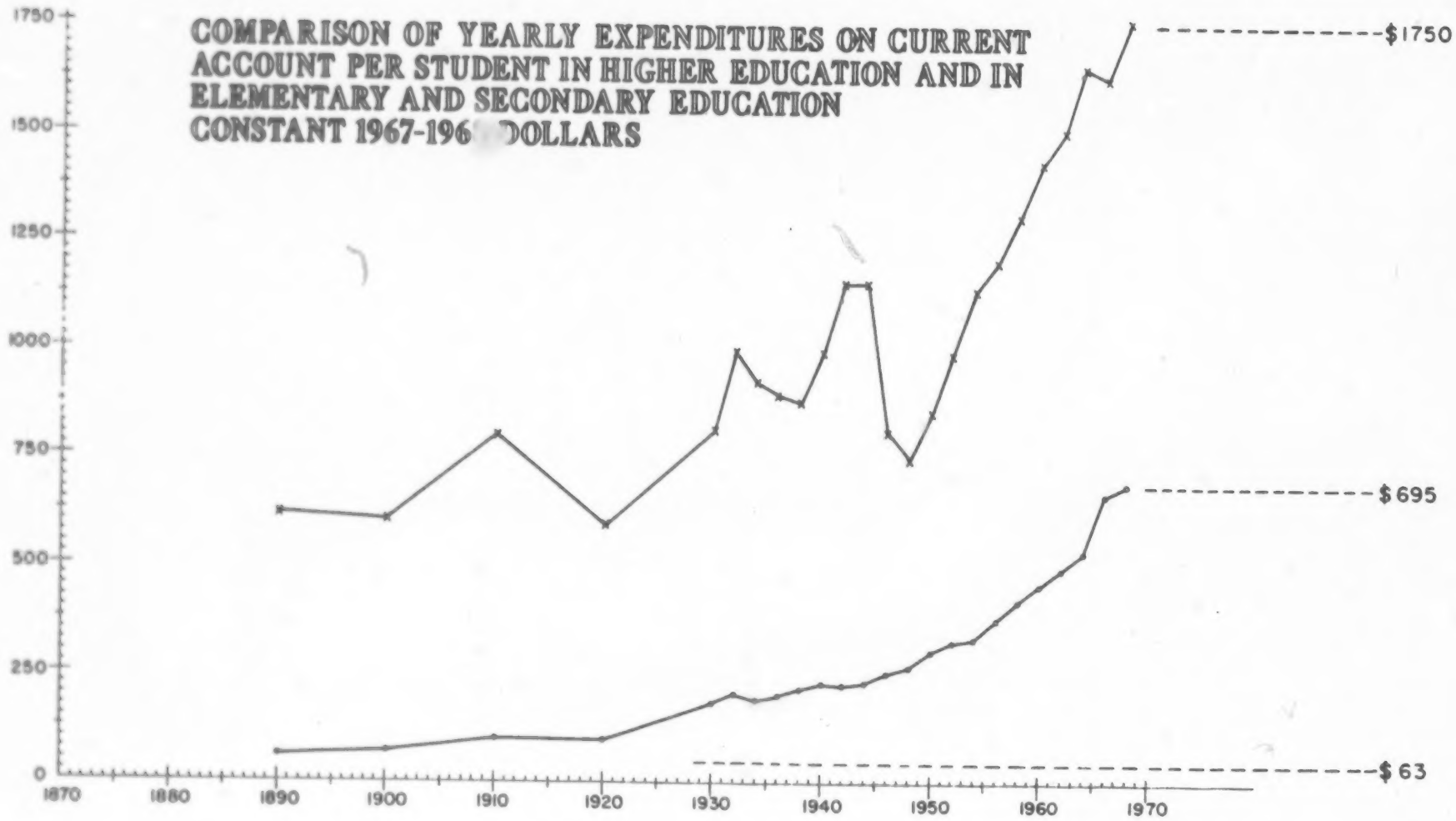
Growth in current expenditures per man-year of instruction produced in both the elementary-secondary component and the higher education component are illustrated by the estimates shown in Chart 12. [11] [12] [13] [14] [15]

The data are expressed in constant 1967-1968 dollars. In preparing these estimates, adjustments were made to available Office of Education data to approximate current expenditures for instructional purposes only. For example, the estimates are not intended to reflect institutional expenditures on auxiliary enterprises such as the operation of dormitories. The estimates do include an allowance for administrative expense (not related to organized research), plant maintenance, and all departmental expenditures. Capital expenditures are not included, however. Annual expenditures are divided by estimates of the number of full-time equivalent man-years of instruction produced at all levels of instruction and deflated by a consumer price index.

CHART 12

A10888

## COMPARISON OF YEARLY EXPENDITURES ON CURRENT ACCOUNT PER STUDENT IN HIGHER EDUCATION AND IN ELEMENTARY AND SECONDARY EDUCATION CONSTANT 1967-196 DOLLARS

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As is evident in Chart 12, the estimates for institutions of higher education are subject to considerably more year-to-year variation than the estimates for the elementary and secondary system. One reason for this is simply that wars and depressions have had a far greater influence on the size of classes at institutions of higher education than for the elementary and secondary system. With sizeable fixed costs, the average expenditure per student at institutions of higher education necessarily shows a wide fluctuation as students have withdrawn during depressions and wars and as institutions accommodated the over-capacity enrollment following World War II.

If one abstracts from the rather wide fluctuations due to the temporary influences on the size of enrollment in higher education, it can nevertheless be seen that average expenditures on current account have followed a long-term pattern of persistent growth which is quite similar in form, if not degree, for both the elementary-secondary system and higher education. Both curves rise with increasing annual increments. However, the rate of increase is quite different for the two components of the instructional system.

Average current expenditures per student in the elementary-secondary system (in constant dollars) has increased by a factor of 11 from 1890 to 1968. However, for the higher education component, the average expenditure has increased only 2.8 times during the same period.

The fact that over long periods of time both components of the instructional system are subject to increasing costs has disturbed many individuals responsible for the administration of the instructional system. Are average expenditures to rise indefinitely? Is education subject to some peculiar affliction which precludes the ability to advance productivity? Are educational institutions capable of accommodating an increasing number of students per dollar expanded?

Chart 13 shows the same data for institutions of higher education as that shown in Chart 12. But, for Chart 13, average expenditures per student are related to the number of students being served. Thus, it becomes entirely possible that, with the exception of years in which sudden and unplanned swings in enrollment occur, average costs per student have increased at a decreasing rate as the number of students being served has increased.[9]

This result is all the more remarkable when one considers the significant growth in graduate instruction relative to undergraduate, the broadening of the curriculum, and the increased levels of instructional complexity dealt with at institutions of higher education over the past 80 years. The particular mathematical function used to describe the smooth dashed line in Chart 13 serves to express this relationship reasonably well for the observation of 1890 as for those observations covering the decade of the 1960's. But, this result has been influenced

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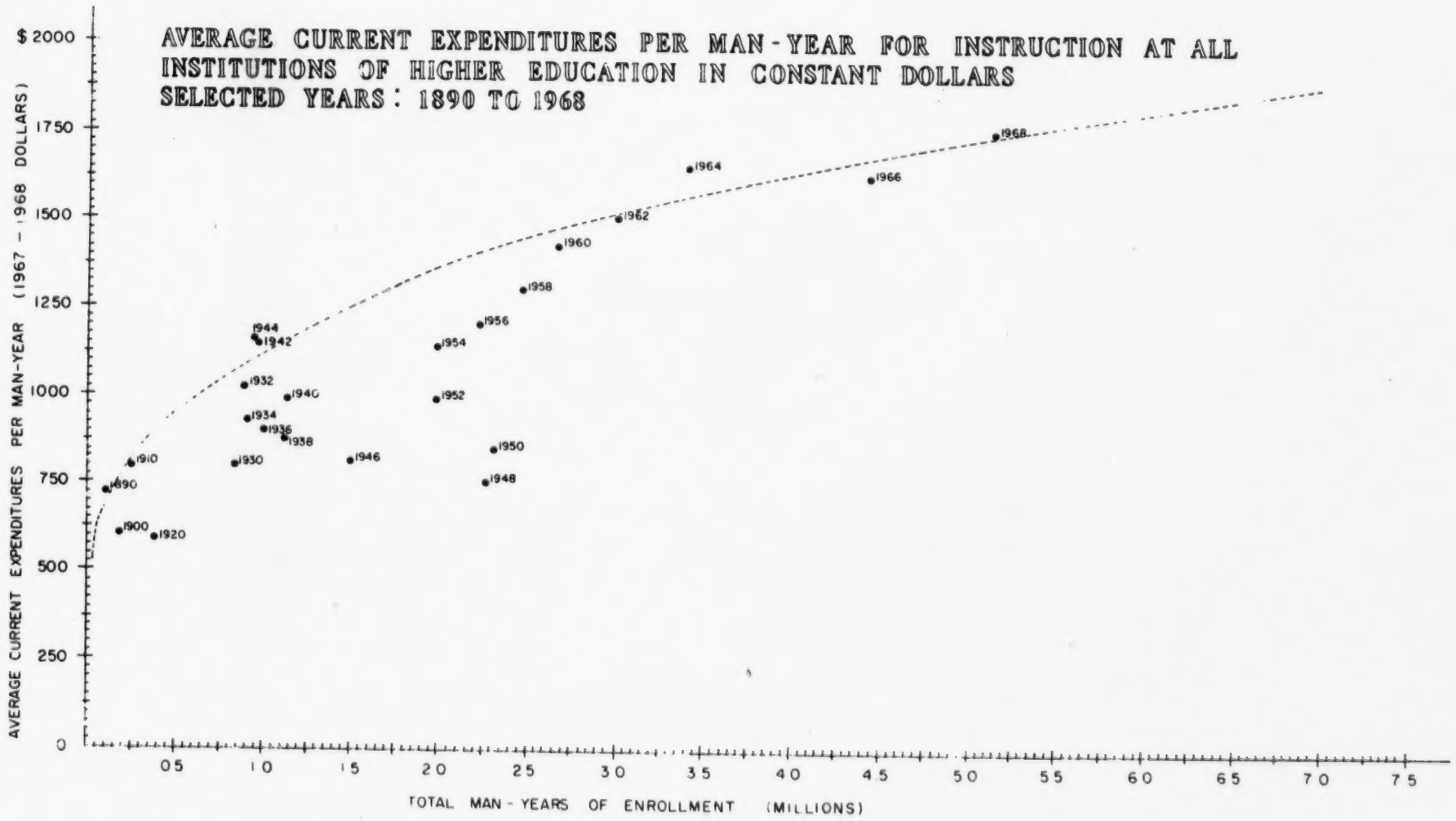
[9] The smooth curve may be expressed as $A = 31.5\ N^{.26}$ where A is the average expenditure per man-year in constant 1967-68 dollars and N is the number of man-years of enrollment. The function is fitted to the data for the years 1890, 1910, 1942, 1944, 1960, 1962, 1964, 1966, and 1968.

CHART 13

AVERAGE CURRENT EXPENDITURES PER MAN-YEAR FOR INSTRUCTION AT ALL INSTITUTIONS OF HIGHER EDUCATION IN CONSTANT DOLLARS
SELECTED YEARS: 1890 TO 1968



to a significant degree by population growth--a factor which is beyond the control of an educational policy which seeks a continuously rising rate of educational attainment.

One may not conclude from this result that should the size of the system stop growing, average expenditures would also stop growing. Quite apart from price changes, rates of growth in productivity continue to be generally lower for service industries than for manufacturing industries. The price of services may thus be expected to continue to rise relative to the price of manufactured goods.

Whether average expenditures per student continue to rise depends essentially upon the amount of faculty and staff time used per student. The behavior of this fundamental ratio over the course of the past half century (not shown here) does not offer much hope that "an education" will become less expensive in the future. In the elementary and secondary system we apparently are now using more faculty and staff time per student than was the case during the 1920's. At institutions of higher education we are now using about the same amount per student as we were 50 years ago, although what constitutes "an education" has been much extended and has become more complex. This suggests that significant technological innovation in education may be used to enhance or extend the instructional process but, except for temporary periods, has not been used to reduce the amount of human resources used per student.

## II. THE FUTURE QUANTITY OF INSTRUCTION

The reader will find no predictions here of the number or proportion of individuals who will complete various levels or years of instruction in the future. That will be very much a matter of public policy. Without knowing what future public policy will be, and what the social response to that policy will be, one cannot predict what future enrollment or completion rates will be.

Private institutions of higher education now depend upon Federal, State, and Local governments for more than 25 per cent of their annual revenue, which proportion does not include loans from governments. [16] Seventy per cent of the total number of individuals enrolled at institutions of higher education in the Fall of 1968 were served by institutions operated by governments. Thus, the interaction between policies followed by governments and educational institutions and the social response to those policies will determine future enrollment and change in the general level of educational attainment. The questions to be addressed, then, are what rational alternative policies might be followed with what results?

There are many important and difficult questions to be addressed regarding the content and form of future instruction at all levels of instruction. There are also difficult questions to be addressed regarding choices between alternative future amounts of instruction given whatever

preferences for content and form may currently obtain. In addition, there are difficult operational questions regarding the manner in which funds may be raised and the manner in which public resources for instruction may be allocated to institutions and individuals. None of these crucial questions are addressed here. What is sought here, however, are some reasonable quantitative limits within which such problems may be addressed.

## A Quantitative Model

Among the many possible alternatives for the future quantity of instruction, two possibilities are presented here based upon certain optional conditions regarding the meaning of equality of educational opportunity. One of these possible future states is the result of a simple extrapolation of past growth in completion rates. Before presenting this quantitative material, however, it will be necessary to describe the model used and the reasons for its selection in preference to many other possibilities.

Any model, either simple or complex, mathematical or non-mathematical, designed to describe the process of educational attainment by the population will essentially describe the attrition phenomena. Within any homogeneous component of an instructional system the proportion of an age cohort completing any given number of years of instruction at any given point in time is some function of the proportion of that age cohort completing prior levels.

There are many mathematical functions which describe this kind of phenomena. For example, the cumulative version of the well known Normal curve is one such function. To serve the present purposes, however, a very simple and easy to use function has been chosen because it describes time processes of the sort under discussion and because it accommodates many of the ideals believed to be widely held regarding equality of educational opportunity. Specifically, the function used here to describe some possible future states for the quantity of instruction will accommodate the following conditions:

1) The instructional system could stand ready to provide any individual with one or more years (or other time units) of additional instruction without limit and without regard to age, prior preparation, social or economic status, or the rate at which the individual is capable of learning.

2) However, the average number of man-years spent in the instructional system during the life of the age cohort would be limited by the social demand for alternative uses for the cohort's time. Except that, each member could be expected to complete the same number of instructional years as any other member of that age cohort.[1]

3) Nevertheless, as life progressed, some individuals would complete

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[1] The word expected is used here with both its common sense meaning and in the sense of a mathematical ex ante expectation. In what follows the common sense terms expect and expected will be used interchangeably with the mathematical term expectation. It is hoped that the consistency of the ideas will remain unchanged with either interpretation.

fewer than the expected number of instructional years and others would complete more than the expected number due to circumstances, which would be purely fortuitous insofar as other individual characteristics like race, sex and original family social status or financial position are concerned.

The mean number of years of instruction ultimately completed by the members of the cohort would remain, nevertheless, equal to the original expectation defined by society's demand for alternative uses of the cohort's time. In other words, the model would define the distribution of the number of years of instruction completed by an age cohort, given the above conditions, but not the average amount.

Under the conditions of this model, should one select a cross section of some future age cohort at some point--say at age 25--he would find no significant differences between those who had completed 16 years of instruction and those who had completed less than 16 years of instruction with respect to <u>any</u> prior characteristic of the individual as measured at birth.

Such a system would, however, admit many individual differences which might develop as time passed. For example, at some point in the life of the age cohort one would expect to find some individuals who had mastered far more complex material than another after an identical number of years

of instruction. One would also expect to find a higher degree of motivation to pursue educational objectives among those who had completed, say, 16 years of instruction than among those who had completed less than 16 years. The only requirement of the model is that at any point in time, the number of years of instruction completed by an individual not be correlated with any prior characteristic which might be measured at birth. Nothing whatever is implied, however, about the content or outcome of that instruction.

The instructional system which actually obtains in the United States is based upon many of these ideals. For example, each member of recent generations has been expected to complete at least 12 years of school, although about 20 per cent of today's 18 year olds will not. Also, the elementary and secondary systems of instruction do generally stand ready to provide an incremental unit of instruction to individuals with widely varying levels of prior preparation and with widely varying learning rates. So, too, does the post-secondary system offer a wide variety of both degree and non-degree programs at many different levels of complexity and content designed to meet the differing needs of many different individuals.

Given the conditions of this model, the proportion of each age cohort ultimately completing 0, 1, 2 or n years of instruction is simply a function of the mean number of years the cohort will ultimately complete.[2]

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[2] The Poisson function is used in what follows to approximate the conditions of the model. This is a function which has been widely used in the physical sciences, engineering, and to some extent in economic models to describe time processes in which the mathematical expectation of an event is identical for each element of a set and in which the events occur fortuitously in a continuum of time. The function is defined in the Technical Appendix.

It is essential to understand, of course, that no such system of instruction as described by the model has ever existed. But a statement of some of the differences between the conditions of the model and the current instructional system in the United States may prove instructive.

For example, it is well established that the number of years of school completed by an individual is correlated with various characteristics measurable at birth. To name just two such characteristics one may mention race and the level of education attained by one's parents. In addition, those born with learning disorders may not be expected to complete the same number of years of instruction as those born in better health. One born into a sub-culture which places a high value on academic pursuits may be expected to complete more years of instruction than one born into a sub-culture in which "book learning" ranks lower in value. And so on. In other words, the mean number of years of instruction expected to be completed by an age cohort is not identical to the expectation for each member of the age cohort.

A second difference, about which more will be said subsequently, is the lack of continuity between instructional years 8 and 9, and between years 12 and 13. This discontinuity was illustrated by the Census data shown earlier and was discussed at some length. It was pointed out that the discontinuity between years 8 and 9 has largely been closed over the course of the 20th century. But the attrition curve for the "regular"

school system as defined for the Census, even within the elementary, secondary and post-secondary components, has not been as smooth as would be the case under the conditions of the model. The proportions of each age cohort completing years 8, 12, and 16 have all tended to be higher than the conditions of the model would produce and the proportions completing years 9 and 13 have been lower than what might be expected under the conditions of the model.

There is, of course, a very plausible reason for this. The instructional time units in the "regular" school system have traditionally consisted of three units of 8, 4, and 4 years respectively, prior to graduate study. Apparently, individuals who have a low expectation of completing any one of these three units on schedule have a tendency not to enter the unit at all. Similarly, those who have entered one of the units may tend to complete the unit "at all cost" in order to avoid a special onus of failure which seems to have been placed on those who do not complete exactly 8, 12, or 16 years of instruction.

Under the conditions of the model no such onus would be associated with any year. It would be necessary for society to judge individuals more on their merits and less on the basis of the number of years of instruction completed. This does not mean, however, that traditional diplomas and degrees would necessarily disappear. Quite the contrary, it might only mean that certain planned programs of instruction, such as a classical BA degree, would carry a social value solely equal to its functional content

and would, perhaps, admit the possibility of more uniform standards being adopted for such programs.

Finally, a fourth property of the model may be described which permits one to set a limit of a particular kind to the amount of time the members of an age cohort may be expected to spend in receiving instruction. But, to describe the use to which this property of the model may be put, it will be helpful to shift the discussion from a lifetime expectation for the number of years of instruction a cohort may receive to the expectation between certain ages, say between age 6 and 23.

4) The expectation for the mean number of years of instruction received by an age cohort between any two ages is also a linear function of time within those age limits.

This condition simply means, for example, that if the expectation (not to be confused with the result) for each member of an age cohort is 16 years of school during the 17 years between the ages of 6 and 23, the expectation is also one year of school by age 7, two years by age 8, four years by age 10, and so on. This is nothing more than the standard linear sequential form in which most individuals perceive the development of educational institutions during the 20th century.

However, the expectation for recent generations has not been anywhere near 16 years of "regular" school by age 23. The age cohort born during

the years 31 through 1935 reached the age of 23 during the years 1954 through 1958 and will be within the ages 35 through 39 during 1970. This cohort has completed a mean of approximately 12 years of "regular" school per person. Put within the context of the model, one may say that the expectation for that cohort was 12 years of instruction by age 35. But neither has the educational attainment of the population developed in the linear fashion described by the property of the model introduced above. Clear evidence was shown in the first section of this paper of the discontinuity in growth between the elementary, secondary and higher education components of the instructional system. Put within the context of the model, this discontinuity can be described by stating that, historically, once an individual completed the 12th grade, the expectation for the number of additional years of school he might complete has been reduced. This is to say, the expectation has not been a linear extension of prior experience.

For example, within the context of the model, the cohort born during the years 1931 through 1935 completed the 12th grade at rates consistent with an expectation of 13.4 years per person by age 35. This same cohort, however, completed 16 years of "regular" school at rates consistent with an expectation of 11.9 years per person by age 35. For this cohort the expectation for the mean number of years of instruction within the "regular" school system fell from prior levels between the high school and college years.

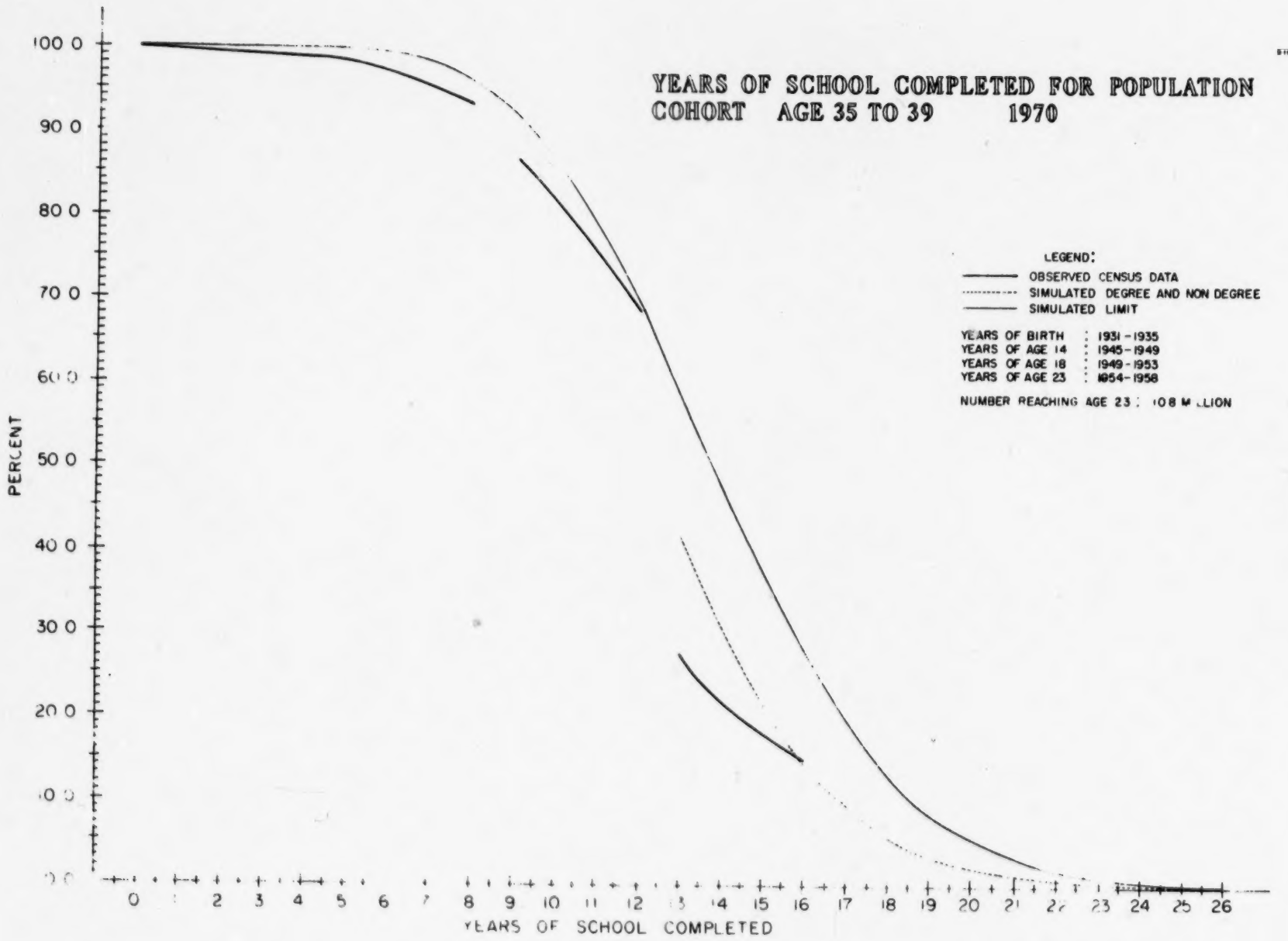
During the 20th century this lack of linearity in the ultimate expectation between elementary and secondary experience has all but disappeared. And, while the discontinuity at year 13 has remained, there is good reason to believe that this, too, is now changing. Thus, one may suggest that the instructional system in the United States has tended to grow toward this linear property described for the model and that a linear extension of that expectation which described observed secondary school experience suggests a reasonable limit to post-secondary experience.

These matters are illustrated in Chart 14. The heavy solid lines of Chart 14 represent the approximate experience of the age cohort which will be age 35 to 39 in 1970 as observed from recent Census reports. The dashed line represents the limits implied by the model consistent with the rate at which the cohort completed 16 years of instruction within the "regular" school system. The thin line represents the limits implied by the model consistent with the rate at which the cohort completed 12 years of instruction within the "regular" school system.

The difference between the model simulation at years 13, 14 and 15 and the Census observations can be accounted for, in large measure, by the difference between degree and non-degree work at institutions of higher education. For example, the typical undergraduate college age years of this cohort--ages 18 through 23--spanned the years 1949 through 1958. During the 1954-55 academic year approximately 95 per cent of total undergraduate

CHART 14

# YEARS OF SCHOOL COMPLETED FOR POPULATION COHORT AGE 35 TO 39 1970




LEGEND:
- OBSERVED CENSUS DATA
- SIMULATED DEGREE AND NON DEGREE
- SIMULATED LIMIT

YEARS OF BIRTH : 1931 - 1935
YEARS OF AGE 14 : 1945 - 1949
YEARS OF AGE 18 : 1949 - 1953
YEARS OF AGE 23 : 1954 - 1958

NUMBER REACHING AGE 23 : 108 MILLION

degree and non-degree enrollment at all institutions of higher education was accounted for by degree-credit work. The area under the dashed line of Chart 14, between years 13 through 16, accounted for by the area under the observed line from Census reports on the number of years of "regular" school completed is approximately 75 per cent. How much post-secondary instruction might have been received by this age cohort outside institutions of higher education is, however, unknown. One implication of this result is that roughly 25 per cent more post-secondary instruction may have been received by this age cohort outside institutions of higher education than the amount received at such institutions. But the facts are not known.

The limiting curve of Chart 14 represents that amount of instruction which might have been received by this age cohort had post-secondary experience represented a continuous function of year 12 completion rates under the conditions of the model.

Given the size of each age cohort and all the conditions of the idealized system of instruction thus far described, one can describe what is implied for the quantity of instruction at each level in the system for any known, planned, or anticipated mean level of educational attainment. Furthermore, by simply adopting a different expectation for different components of the system--elementary, secondary, tertiary, or graduate--one may produce any degree of discontinuity (or rate of closure) one might wish in allowing for non-linearity of the expectation.[3]

[3] There is at least one good reason for this non-linearity. The more one learns, the more valuable his time becomes to the rest of society. Thus, to spend time in instruction becomes more and more expensive relative to other pursuits as the amount of instruction received increases.

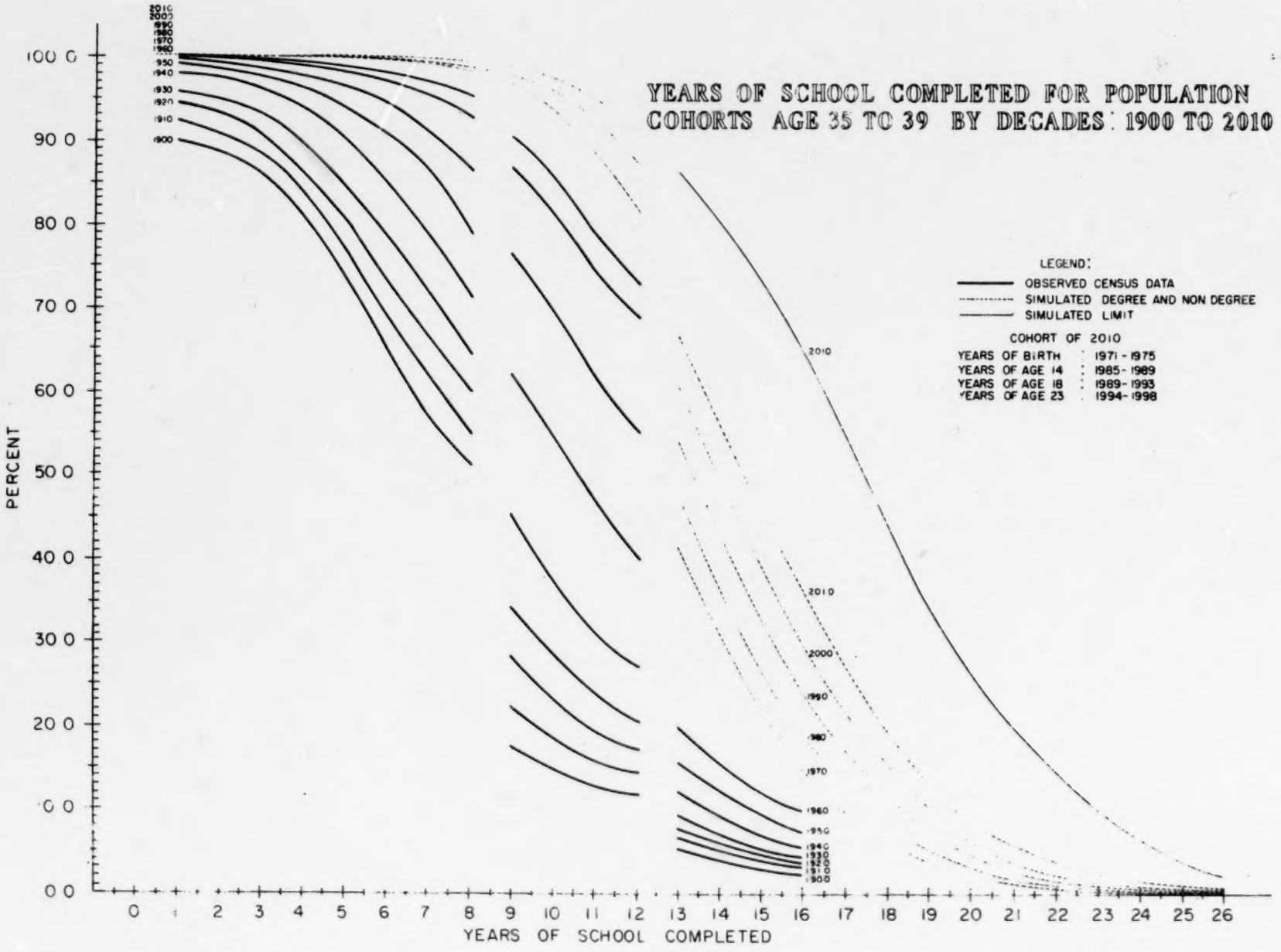
Finally, one may also use this general model to reproduce some historical results in a usefully approximate way despite the fact that the conditions for equality of opportunity have not been met. The reasons for this are that educational attainment is a sequential time process in which the expectation for an age cohort has been generally linear over certain ages. And, even though different subgroups of each age cohort have historically achieved significantly different levels of instruction at identical ages, relative differentials have, until recently, been maintained over most of the 20th century. But this also is changing.

## Two Alternative Futures

The purpose of all this, however, is not to predict the future or to accurately reproduce historical results. The purpose is to describe as rigorously as possible some feasible alternative future states which might be desired and then, through analysis, describe what may be required of sets of public and private policies and the social response to such policies in order to achieve each. Only two such alternatives are described below and compared with implications of current trends. Nothing will be said here, however, about how we as a society might achieve these alternatives or whether we might wish to achieve either.

Chart 15 shows some results of what might be termed a continuous growth policy. These results stem from the single assumption that completion

CHART 15

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rates for the elementary, secondary and post-secondary systems will continue to rise following the historical trend which has held roughly consistent since about 1910.

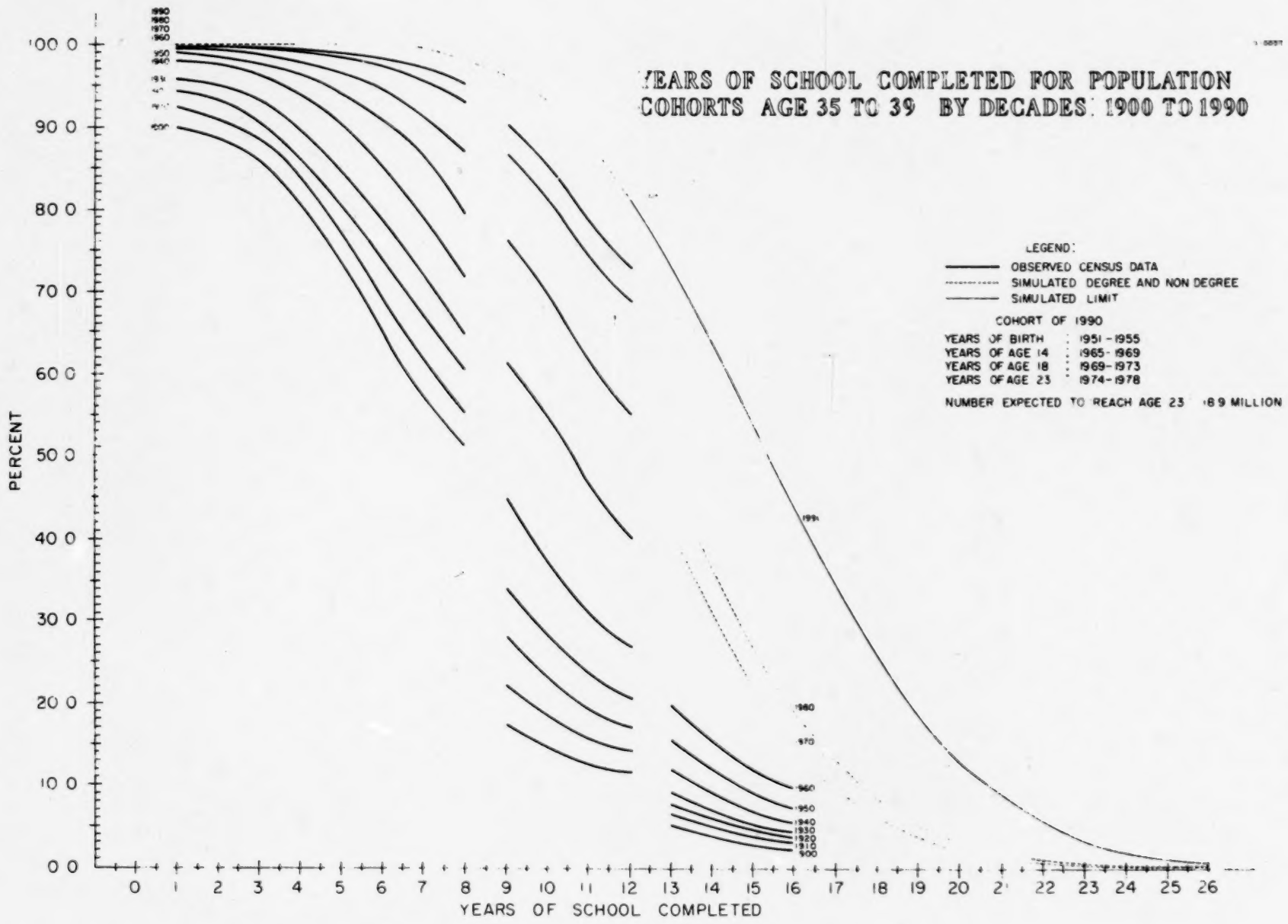
Specifically, the model expectation which is consistent with elementary and secondary experience will continue to rise at the rate of roughly 1 year per person per decade. This implies that 12th year completions would reach about 92 per cent for the age cohort to be born during 1971 through 1975. This group will be age 35-39 in the year 2010.

Similarly, the model expectation which is consistent with completion rates at year 16 will continue to rise at the rate of roughly 0.6 years per person per decade. This implies that completion rates for year 16 would reach approximately 35 per cent for the age cohort to be born during 1971 through 1975.

The thin line which continues the high school experience for this cohort shows that, under these assumptions, post-secondary experience would remain a discontinuous function of secondary experience. But high school to college entry rates would rise nevertheless.

Chart 16 shows what might be the result of a stability policy. That is to say, one alternative would be to cause post-secondary experience to become a continuous extension of secondary experience under the conditions

CHART 16


YEARS OF SCHOOL COMPLETED FOR POPULATION COHORTS AGE 35 TO 39 BY DECADES: 1900 TO 1990
LEGEND:
OBSERVED CENSUS DATA
SIMULATED DEGREE AND NON DEGREE
SIMULATED LIMIT
COHORT OF 1990
YEARS OF BIRTH : 1951 - 1955
YEARS OF AGE 14 : 1965 - 1969
YEARS OF AGE 18 : 1969 - 1973
YEARS OF AGE 23 : 1974 - 1978
NUMBER EXPECTED TO REACH AGE 23 1.89 MILLION
PERCENT
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
YEARS OF SCHOOL COMPLETED
1990
1980
1970
1960
1950
1940
1930
1920
1910
1900

of equality of opportunity described earlier. But further growth in the mean level of educational attainment as measured by years of instruction within the formal system would stop. Thus, following the age cohort born during 1951-1955, who will complete secondary instruction during the years 1969-1973 at roughly the rates shown, that and all subsequent generations would complete any given number of years of instruction at stable proportions.

Beginning with this generation, about 82 per cent would complete 12 years of instruction, about 43 per cent would complete 16 years, about 25 per cent would complete 18 years, and about 1 per cent would complete 25 years of instruction.

Of course, many other alternatives are possible. But these two kinds of extremes have been chosen because it is believed that a careful analysis of the feasible policy alternatives which would be required to reach either of these future states may reveal much of importance to the current and continuing process of policy formation.

SOURCES


[1] Number of High School Graduates 1870-1956: U.S. Bureau of the Census, Historical Statistics of the U.S., Series H232. 1957-1968: U.S. Office of Education, Projections of Educational Statistics to 1976-77, Page 30, Table 17.

[2] Population by Single Years of Age 1900-1968: U.S. Bureau of the Census, Current Population Reports, "Population Estimates," Series P-25, No. 311, No. 321, No. 385, and No. 416. 1870-1900: Interpolated estimates of the number of persons 18 years old based on Decennial Census Reports. Projections 1968-1986: EPRC estimates based on survival rates from U.S. Department of Health, Education and Welfare, United States Life Tables: 1959-61, Volume 1, No. 1.

[3] Number of Bachelor's or First Professional Degrees Awarded 1870-1956: U.S. Bureau of the Census, Historical Statistics of the U.S., Series H330. 1957-1968: U.S. Office of Education, Projections of Educational Statistics to 1976-77, Page 31, Table 18.

[4] Exposed Population for BA Level Degrees 1900-1968: A weighted average of the number of persons by single years of age from age 21 through age 31 inclusive. Estimates of the population by single years of age from source [2] above. Weights represent the proportions of all fourth-year students in the respective age groups from source [5] below.

[5] U.S. Bureau of the Census, Current Population Reports, "Population Characteristics," Series P-20, No. 167, Page 16, Table 10.

[6] Total Undergraduate Enrollment at Institutions of Higher Education 1870-1956: U.S. Bureau of the Census, Historical Statistics of the U.S., Series H323. 1957-1968: U.S. Office of Education, Projections of Educational Statistics to 1977-78, Page 12, Table 4.

[7] First-Time Degree-Credit Enrollment at All Institutions of Higher Education and at Junior Colleges 1939-1960: U.S. Office of Education, Opening Fall Enrollment in Higher Education, 1960: Analytic Report, OE-54007-60, Page 11, Table 6. 1961-1967: U.S. Office of Education, Projections of Educational Statistics to 1977-78, Page 13, Table 5 and Page 15, Table 7. 1968: U.S. Office of Education. Opening Fall Enrollment in Higher Education: Part A - Summary Data, 1968, Page 26, Table 4.

[8] U.S. Bureau of the Census, Current Population Reports, "Population Characteristics," Series P-20, No. 182, Page 9, Table 1.

[9] Number of Master's or Second Professional Degrees Awarded 1870-1956: U.S. Bureau of the Census, Historical Statistics of the U.S., Series H333. 1957-1968: U.S. Office of Education, Projections of Educational Statistics to 1976-77, Page 31, Table 18.

[10] Number of Doctor's or Equivalent Degrees Awarded 1870-1965: U.S. Bureau of the Census, Historical Statistics of the U.S., Series H336. 1957-1968: U.S. Office of Education, Projections of Educational Statistics to 1976-77, Page 31, Table 18.

[11] BASIC DATA: Institutions of Higher Education--Current Expenditures 1930-1962: U.S. Bureau of the Census, Historical Statistics of the U.S., Series H351 -H361. 1964: U.S. Office of Education, Higher Education Finances, June 1968, Page 3, Table 1. 1966: U.S. Office of Education, Financial Statistics of Institutions of Higher Education, 1965-66, Pages 12-13, Table 3. 1968: Estimates from U.S. Office of Education, Projections of Educational Statistics to 1977-78, Page 92, Table 46. 1890-1920: Result described below extrapolated on the basis of Total Current Income.

ADJUSTMENTS: EPRC estimates of Total Current Expenditures for Student Instruction 1890-1968: Includes administration and general expense, departmental instruction and research, libraries, plant operation and maintenance, and activities related to instructional departments LESS: 25 per cent of amounts spent on organized research to cover administration and plant operation related to organized research. The result was then deflated by the price index described in source [15] below.

[12] Man-Years of Degree-Credit Instruction at Institutions of Higher Education 1870-1955: EPRC estimate derived by summing a 4-year moving total of BA level degrees awarded, a 2-year moving total of MA level degrees awarded, and a 4-year moving total of Ph D level degrees awarded. This result was then multiplied by a constant to approximate the level of full-time equivalent enrollment as estimated by the U.S. Office of Education for the 1958-1968 period. 1956-1968: U.S. Office of Education, Projections of Educational Statistics to 1977-78, Page 24, Table 16.

[13] Current Expenditures of Public Elementary and Secondary Schools 1870-1962: U.S. Bureau of the Census, Historical Statistics of the U.S., Series H252 - H261. 1964, 1966, and 1968: U.S. Office of Education, Digest of Educational Statistics, 1968, Page 57, Table 68 and Page 59, Table 70. In each case capital outlay was omitted. The result was deflated by the price index described in source [15] below.

[14] Man-Years of Instruction at Public Elementary and Secondary Schools 1870-1962: U.S. Bureau of the Census, Historical Statistics of the U.S., Series H229 (Number of students in average daily attendance). 1964 and 1966: U.S. Office of Education, Digest of Educational Statistics, 1968, Page 29, Table 29, and Page 26, Table 27.

[15] Consumer Price Index 1869-1962: U.S. Bureau of the Census, Historical Statistics of the U.S., Series E113 and E157. 1963-1968: Council of Economic Advisers, Economic Report of the President, January 1969, Page 279, Table B-45. Indexes adjusted to a common base and converted to a school-year basis with a two-term moving average.

[16] U.S. Office of Education, Projections of Educational Statistics to 1977-78, Page 135, Table Q.

## TECHNICAL APPENDIX

For the model described in Section II of this paper, the probability $p_n$ of exactly n years of instruction is given by the Poisson function:

$$p_n = \frac{x^n \; e^{-x}}{n!}$$

where x is the mean number of years of instruction.

The probability $P_n$ of <u>n or more</u> years of instruction (as shown, for example in Charts 14, 15, and 16) is simply the cumulation:

$$P_n = p_n + p_{n+1} + \cdots\cdots + p_{n+m}$$

where the value of m is chosen to give any desired level of precision.